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# RINDERPEST STUDIES

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FIFTEEN TEST FIGURES

# I. ANTIRINDERPEST IMMUNE AND HYPERIMMUNE SERA

Ruedigor (1910) and Hall (1933, cited by Bennett, 1934) both failed to notice any difference in the "titre" or protective value of "non-reactor" and "reactor" immune sera. But Ward and Wood (1912) demonstrated that the latter is more highly protective, as animals injected with it developed an average of 9.7 days of diagnostic symptoms plus febrile period as against 12.1 days among those given the nonreactor serum. On the other hand, Carmichael (1928) claims that nonreactor sera are useless.

Opinlons are likewise at variance as to what factors determine the titer of a reactor immune serum. Edwards (1925) and Carmichael (1928) agree that such titer varies in direct relationship to the severity of the original reaction. On the contrary, Bennett (1934) claims that immune serum from cattle that have undergone a partially controlled attack of rinderpest "is of extremely variable potency; the potency, moreover, appears not to hear a constant relation either to severity of the symptoms or to the intensity of any particular symptom." In fact Kearney (1925, cited by Bennett, 1934) observed by parallel tests that serum from a beast that had given the lesser preliminary reaction gave better results. Topocio (1922) on the other hand showed that a febrile reaction of 89.5° to 40° C. and above for three or four consecutive days can produce a

reactor scrum that he found to be as potent as the hyperimmune sera manufactured in the Philippines, the Pasteur Institute of Nathrang, and the laboratories of Harbin.

With regard to the effect of hyperimmunization, Edwards (1925) believes that "subsequent to the initial treatment of the serum producers there occurs what appears to be a maximum diffusion of the virus throughout the body which results in the development of such a state of immunity on the part of the tissues that the injection afterwards of the amounts of virus that are contained in massive quantities of virulent ox blood set up no more than a local disturbance naite incapable of evoking a tissue response sufficient to drive up the antibody content of the blood beyond the maximum titre attained following the preliminary treatment." Daubney (1928) appears to hold the same view. The work of Ecnnett (1934), however, demonstrates that "beasts providing intinues serum of low potency will provide hyperimmune serum of high value after immunization." Rabagliati (1925) likewise proved that serum produced after Todd's method of hyperimmunization was more potent than the ordinary reactor serum.

Some of the controversial aspects of the subject of "immune and hyperimmune serums" are thus indicated. So with a view of shedding more light on these aspects, the following experiments were undertaken.

#### MATERIALS AND METHODS

## NONREACTING INSIGNE SERA

(1) NR-3408.—This was obtained from Fuga bull 3409 (fig. 1), which was vaccinated with 10 cc of phycerine-formolized rindorpest vaccine September 24, 1934; ineculated with 1 cc of fresh viculent blood October 10; developed no reaction thereafter; and finally was blod for scrum November 5, 26 days after vivus ineculation.

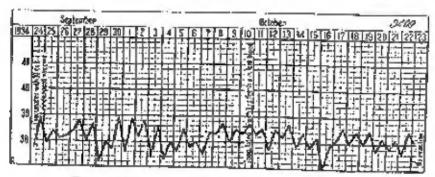
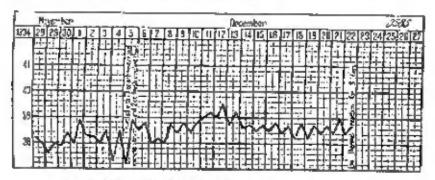


Fig. 1. Tomperature thart of Supremator secure producer 7449.

- (2) NR-3510.—This was obtained from Fuga bull 3510, which was vaccinated with 0.5 g of dried rinderpest vaccine October 24, 1934; inoculated with 1 cc of fresh virulent bland November 7; developed no reaction thereafter; and finally was bled for serum November 29, 22 days after the virus inoculation.
- (3) NR-9586.—This was obtained from Fuga bull 3680, which was vaccinated with 5 g of dried rinderpest vaccine October 23, 1935; inoculated with 0.5 cc of fresh virulent blood Navember 26; developed no reaction thereafter; and finally was bled for serum December 9, 14 days after virus inoculation.
- (4) NR-3694.—This was obtained from Fugu bult 3084, which was vaccinated, reacted, and was bled in the same manner as NR-3690.

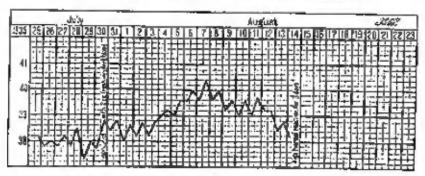
#### MILD REACTION INDICATE SERIA

(1) TR-35%...-This was obtained from Fuga ball 3585 (fig. 2), which was simultaneously injected with 70 ec of antirinderpost immune serom and 2 ec of fresh virulent blood December 5, 1934; developed a low thermal reaction (below 40° C.) for 3 days; and finally was bled for serum December 27, 22 days after virus inoculation.



Fat, 2. Temperature that I of wild search record produces that.

(2) PR-1662.-This was obtained from Tayabas ball 3832 (fig. 3), which was ineculated with 2 or of fresh virulent blood July 30, 1935; developed a high thermal reaction (40° C, or over) for it days; and finally was bled for serum August 20, 21 days after virus ineculation.



Pro. 3. Temperature shart of mild reacter serum producer \$662.

(3) TR-2222.—This was obtained from Fuga hull 3250 (fig. 4), which was vaccinated with 0.5 g of dried rinderpost vaccine September 19, 1934; insculated with 1 se of fresh visulent blood October 3; developed a high thermal reaction for 3 days; and finally was bled for serum November 5, 33 days after visus insculation.

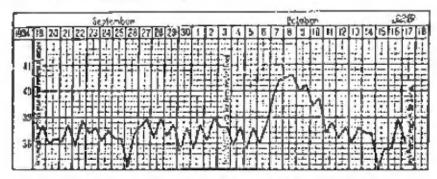


Fig. 4. Temperature chart of mild resetur scrum producer 3239.

#### MARKED REACTOR IMMUNE SERA

(1) TR-2566,—This was obtained from Fuga bull 2566 (fig. 5), which was vaccinated with 0.5 g of dried vinderpest vaccine April 21, 1935; insculated with 2 cc of fresh virulent blood May 7; developed a high thermal reaction for 4 days; and finally was bled for screen May 26, 19 days after virus inscellation.

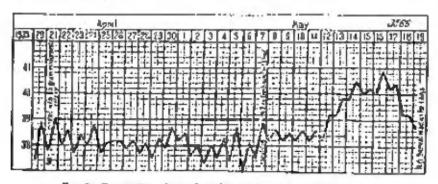


Fig. 3. Temperature shart of marked retains serum produces 3365.

- (2) TR-3623.—This was obtained from Faga bull 3623, which was inoculated with 10 cc of fresh virulent blood August 7, 1934; developed a high thermal reaction for 5 days; and finally was hied for servin August 23, 21 days after virus inoculation.
- (3) TR-3566.—This was obtained from Rombion bull 2060 (fig. 6), which was simultaneously injected with 10 ec of antirinderpest immune scrum and 2 ec of fresh virulent blood July 30, 1935; developed a high thermal reaction for 6 days; and Smally was bled for serum September 3, 25 days after virus inoculation.

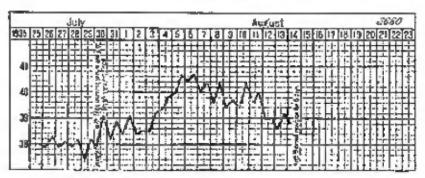


Fig. 0. Temperature share of marked practor serum producer 3000.

- (4) TR-3408.—This was obtained from Fuga bull 3402, which was vaccinated with 10 ec of glycerine-formolized rinderpest vaccine September 27, 1934; inoculated with 1 ec of fresh virulent blood October 10; developed a high thormal reaction for 6 days; and finally was bled for serum Norumber 1, 22 days after virus inoculation.
- (5) RR-3420.—This was obtained from Fuga ball 2420, which was vaccinated with 10 cc of glycerine-formalized rinderpest vaccine September 27, 1934; inoculated with 1 cc of frosh virulent blood October 10; developed a severe rinderpest reaction (high thermal reaction for 5 days plus diarrhess for 2 days); and finally was bled for serum November 5, 26 days after virus inoculation.

#### HYPERIMMONE SERA

(1) HI-3541 (from a marked reactor with a lapsed titor).—This was obtained from Fuga bull 2541, which was simultaneously injected with 12 cc of antirinderpost immune serum and 2 cc of frosh virulent blood February 20, 1935; developed a high thermal reaction for 6 days; was injected intramuscularly with 1,500 oc (7 cc per kilo body weight) of frosh virulent blood June 3 (103 days after the preliminary virus Inocalation) and a similar amount June 13 (fig. 7); and finally was bled for hyporimmune serum June 24, 11 days after the last massive virus injection.

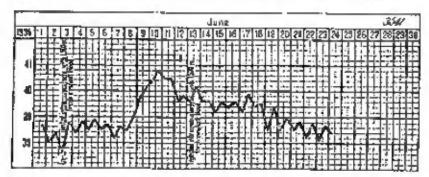


Fig. 7. Temperature chart of hyperimanous person producer 3541 (formerly producer of market spaces secum. TR-354)).

(2) HI-3525 (from a mild reactor).—This was obtained from Fogs bull 3585 (producer of mild reactor serum, TR-3585), which was injected intramuscularly with 3,000 ce (17 ce per kilo body weight) of fresh virulent blood December 29, 1904 (24 days after the preliminary virus innentation), and a similar amount January 2 (fig. 8); and finally was bled for hyperimmune serum January 24, 14 days after the last mussive virus injection.

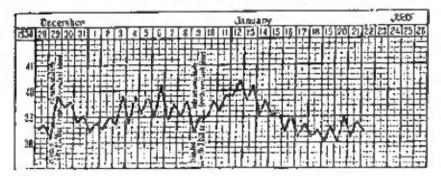


Fig. 3. Temperature chart of hyperformance means precise a 25th 4 formerly predictor of mitch reactor secure. Th-35d51.

(3) HI-3203 (from a marked reactor).—This was obtained from Fugabull 3403 (producer of marked reactor serum, TR-3403), which was injected intramuscularly with 4,000 cc (10 cc per kilo body weight) of virulent blood November 7, 1934 (28 days after the preliminary virus inoculation), and a similar amount November 14 (5g. 9); and Soully was bled for hyperimmune serum Occumber 10, 26 days after the last massive virus injection.

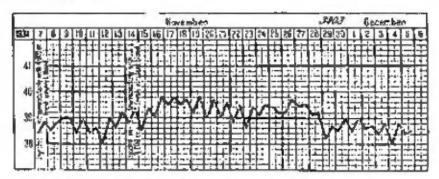


Fig. 9. Temperature chart of hyperineuros secum producer 2102 Hormonly producer of marked renotes secum, TR-3668).

(4) HI-3566 (from a marked reactor).—This was obtained from Fuga bull 8566 (producer of marked reactor serum, TR-3560), which was injected intramuscularly with 1,500 cc (7 cc per kilo body weight) of fresh virulent blood June 3, 1935 (27 days after the preliminary virus ineculation), and a similar amount June 13 (fig. 19); and finally was bled for hyperimmune serum June 24, 11 days after the last massive virus injection.

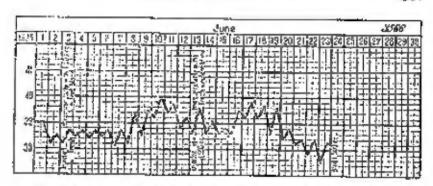


Fig. 16. Temperature chart of hyperimonous scenar producer \$200 (formerly pendager of marked spectar, TE-2566).

#### PREPARATION OF THE BERUM

Blood drawn from each serum producer was collected in 2-liter sterile Pyrex bleeding tubes which contained 10 cc of 95 per cent ethyl alcohol. It was then allowed to stand at room temperature for 24 hours, after which the serum was poured into appropriate containers and subsequently stored at 0° to 3° C, until used.

#### METHOD OF TESTING THE SERCE.

Native cattle 2 to 4 years old and weighing from 175 to 286 kilos were used; and these animals, coming from Fuga, Rombion, and Zamboanga where rinderpeat has not been known to exist for many years, are noted for their high susceptibility to rinderpest. The required dose of serum, which was based on the body weight, and 2 cc of fresh virulent blood were simultaneously inoculated into these animals. (Controls were likewise inoculated with the blood used in each test; all of them developed clinical or severe rinderpest reactions.)

Those animals that failed to show any response to the virus within a period of two weeks were declared to have had no reaction; those which had developed only a temperature response were either considered to have had a low (below 40° C.) or a high (40° C. or over) thermal reaction; those which had exhibited visible clinical symptoms of rinderpest, such as lacrimation, nasal discharges, and month ulceration, were said to have had a clinical rinderpest reaction; and those which had developed the above-mentioned clinical symptoms plus diarrhea, were considered to have had a severe rinderpest reaction. The last two types of reaction were interpreted as negative results, for in both instances inadequacy of protective power was evident.

# TESTS AND RESULTS

#### NUNREACTOR IMMUNE SERA

As shown in Table 1, of the two test animals injected with 10 cc per 100 kilos body weight of nonreactor serum, none was adequately protected; but at 40 cc the serum showed a high degree of protective power. And in two other tests (experiments 5 and 6) an equivalent dosage of 100 cc of nonreactor serum was sufficient to prevent any reaction in the test animals.

TARLE 1 Tests	eh :	Montreuelbr	SERVICE NAME	sere and	resuits.
The configuration of the confi		MANUAL CONTACTOR	dendaring a said	Other St. Where Ser	

Bapers ment No.	No.	Donage pro 100 kilos.	Actual dose.	Bull No.	Results after visus Inconstitues
	Wind the second	46	er.		
1	NR-2000	40	113	3623	High thermal reaction for I day.
2 5	NR-4409	10	22	HR31	Clinical rinderpost reaction.
21	MIE-3510	40	34	3302	Fligh thermal reaction for 3 days.
4	N'K 3010	10	923	5567	Sever einderpest teaction.
6	NIK BEHO	100	200	2680	No reaction.
6.	NIE 3684	100	130 ;	3689	Do.

#### REACTOR IMMUNE SERA

The results shown in Table 2 indicate that mild reactor sera, when given at 10 cc per 100 kilos body weight, were able to protect 1 of 5 test animals; while the marked reactor sera were able to protect in 6 of 7 tests. Likewise, at the equivalent dosage of 40 cc, the former protected 1 of 3 test animals. It would thus appear that the minimum protective dose of the mild reactor serum lies above 40 cc and that of the marked reactor serum is at 10 cc per 100 kilos body weight.

In actual practice, however, the use of such minimum dosage is attended with some risk, as very susceptible animals (see experiment 19) may not be adequately protected by it.

#### HYPERIMMUNE SERA

As seen in Table 3, all of the hyperimmune sera were protective at 10 cc per 100 kilos body weight; but at 5 cc 4 of 8 test animals developed clinical or severe rinderpest reactions. Hence, for practical purposes the amount of 10 cc per 100 kilos body weight may be considered as the minimum protective dose of the hyperimmune sera.

The beneficial effect of hyperimmunization on marked reactor sera, TR-3403 and TR-3566, was thus practically nil. However, in the case of the marked reactor serum, TR-3541, the

titer of which was allowed to lapse, and of the mild reactor serum, TR-3585, the increase in titer is clearly apparent.

TABLE 2.—Tests on seactor improve sera and results.

4		10 20 0000	ALL DESCRIPTION				
	Eappyl- ment No.	Section No.	Dosage pre-	Actual dose-	Bull No.	Results after view impaintion	
		***	re e	- 10 3			
	i		. ota	ec.			
	7 ]	TR-35AS	40 !	120 j	3561	Clinical tindespent mattion.	
		TR ASAS	10	19	2698	High thermal praction for 3 days.	
	9-1	7716-3685	10 1	23	3675	Severe sinderpret reaction.	
	10	TR-3662	40	TO:	767	High thermal reaction for 3 days.	
	1.0	T18-3569	10 %	23 (	3654	Sovero cindespent reaction.	
	12	TR 3002	10 1	En S	3053	100.	
	13	TR 3289	40	70 :	3484	Do.	
	14	T14-3259	10	21	3569	bo.	
	15	TR-2666	10	39 ,	3662	High thereast reaction for 5 days.	
	16	TH -3566	6	100	3693	High thermal resistantian Lat & days.	
	17	TR 3566	انتا	100	30.99	Do-	
	18	TM-0533	70 (	20 3	2704	Bigh thermal reaction for 5 days.	
	19	TR-3823	40 ;	10 4	TERS.	Severe studerpeat renetian.	
	20	TR-3660	[ 19	18.	3668	High thermal reaction for & days.	
	21 1	TR-3660	10	21	3653	High thermyd feathing for a days.	
	22 -	TJ2 \$40\$	40 ;	93	3526	No reaction.	
	23	Tet-3603	20	43	3524	High thermal reaction for I day.	
19	24	TI4-3603	20	36	3163	High thermal reaction for 4 days.	
	25	T14-3403	10 /	19	0578	Bigh thermal reaction for 5 days.	
-	26 1	lent - 3420	48	70	0.585	Low thermal reaction for 5 days.	
1	27	Aft: 3420	10	20	3556	Law thurmal reaction for 4 days.	
	,	- Linearie		American S		1.00	

TABLE 3.-Trate on hyperimmune sere and results.

Espection Ma.	Forum.	Desage per 180 kilon	Artgal dore.	Bull No.	Rosults after virus instalation.
	- 3	berry or		75.3	
. 1		er.	001		
€E .	· 311-0541	10	19	2616	High thermal rearties for 5 days
29 1		F-5	10	3617	Do.
30 7	361-3541	; B	13	5692	High thermal reaction for 6 days.
ar .	TI-Simo	10 7	21	2512	Do.
22	HT-AMA	E 1	14 .	3605	Clinical sinderpres resetion.
28	MI- DAME	6.5	34 .	3249	Severe planterpeat reaction.
34	HI-3402	1 10	27	3456	No reaction.
39	111-3403	11 1	21	3564	Lew thormal reaction for 7 days.
86	101-3403	h [	12	3641	Clinical canderpest reaction-
37	1ft-3603	1 3	91	3574	Severe rinderpost reaction.
38	DEL 3566	1 61	(1)	3707	
89	H (-3968	1 61	12	A Polit	High thermal reaction for 5 days.

<sup>4</sup> This serum print to hyperinementation folice to protect built 5039 at 60 cc and hult 3036 at 30 cc ter 100 killer hopy weight.

#### COMMENT

The data presented herein are far from being conclusive in some respects, but the indications are clear. So, if we regard

the few discrepant results as being largely due to marked differences in the susceptibility of the test animals used, the data will serve as a basis for a rational interpretation of some of the existing controversial opinions on the subject.

In the present study the tests were performed on individual samples of immune and hyperimmune sera. Resides, the thermal response was adopted as the guide in determining the severity of the original reaction of the serum producers. Consequently it was possible to correlate with certainty such reaction to the titer or protective value of the serum produced, which otherwise would not be possible to do if "pooled samples" were used.

The use of "pooled samples," as herotofore practiced by many investigators, should thus be looked upon as one of the most fruitful sources of the so-called "surprising experimental results." In the first place the average titer of a pooled sample is difficult to forefell. It may be high or low depending on the predominance of sera of correspondingly high or low titer. Thus, if the reactor scra listed in Table 2 were pooled their average titer might be equal to that of the nonreactor scrum, as claimed by Rucdiger (1910) and Hall (1933), or it might be slightly higher (Ward and Wood, 1912). Similar contrasting results might likewise be obtainable from a pooled sample of the hyperimmune sera shown in Table 3. Furthermore, the correlation of the average titer to the original reaction of the serum producers is obviously difficult or confusing. This is especially true when so many variable factors, such as temperature and visible clinical symptoms (catarch, stomatitis, and diarrhosa) are considered in the interpretation of such reaction.

Another source of confusion is in the use of excessive amounts of serum. As seen in Table 1, a dose of 100 cc of nonreactor strum per 100 kilos body weight prevented the development of any reaction. Such result cannot certainly be improved by any reactor or hyperimmune serum. Hence, it would appear that the determination of the minimal protective dose of any anti-rinderpest serum should precede the assessment of its relative efficacy; otherwise the latter loses its significance and value.

So, Stewart (1935), after having observed that field sera manufactured by the process of selecting serum makers on the basis of visible or severe reactions were of varying potency, decided to adopt the thermal response alone as the basis of selection. He used only serum from bovines that had a rise

in temperature of 2° F, above normal for at least two days. As a result he reduced the losses from 6 per cent (when visible chaical symptoms were considered in the selection) to only 1.97 per cent, among 18,580 and 10,047 animals, respectively

Stewart has thus indicated that the thermal reaction of the serum producer has a direct influence on the titer of its serum. This is corroborated by the results displayed in Table 2, although they also show that a satisfactory reaction in one place may not be the same for another. Under Philippine conditions a thermal reaction of 10° C, or over for at least four days seems to be most suitable for the production of the highest titer in the reactor sera.

That a marked thermal reaction is accompanied by the production of an immune serum of highest titer is thus demonstrated. But as to whether a "maximum titer" is attained after such preliminary reaction to the vicus inoculation is still a controversial point. Edwards (1925) claims that such fiter is teached, no matter whether the reaction is "blocked-out" "nearly blocked-out," or "mild, but decided," but Rabaghati (1928) and Bennett (1934) demonstrated that the titer of a pooled reactor serum is invariably increased after hyperimmunezation. The data presented in Table 3, however, do not seem to give unequivocal support to either of the above observations. On the other hand the results show that hyperimmunization caused only a noticeable increase in the later of a marked reactor. strum (TR-3541) whose titer was allowed to lapse, and of a mild serum (TR-3585), but such effect was practically ml on marked reactor sera, TR-3403 and TR-3566. The results obviously tend to prove that a maximum titer has already been attained prior to hyperimmun.zation in the last two marked reactor sera, which was not the case in the first two sera (see text fig. 11).

The following observations, therefore, may be derived from Table 3: (a) Hyperimmunization, like any other biological procedure, has its limitations, which should not be gnored in order that its usefulness may not be unduly exaggerated; (b) the use of 7 cc of virulent blood per kilo body weight was followed by the production of a relatively higher titer (see III 3541 and HI-3566) than the use of an equivalent dose of 17 to 19 cc are HI-3585 and HI-3403), this apparently means that the optimum (?) amount of virus was already present in the smaller desage and that any excess had no beneficial effect, and if it had

any at all, it was harmful, (c) there seems to be a direct temtionship between the thermal reaction noted in the temperature charts of hyperimmune serum producers HI-3011 and HI-3585 (figs. 7 and 8), and antibody production, that such behavior was not merely accidental is indicated by the absence of similar reactions in the temperature charts of hyperimm inc serum pro-

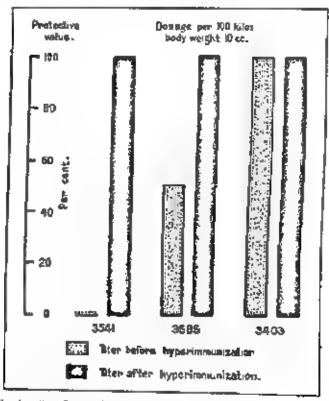


Fig. 23. Showing the effect of hyperimmunication on the titer of anticipaterpeat teacter (one Tables 2 and 3).

accers H1-3403 and HI-3566 (figs 9 and 10). Observations beand c, however, require further experimental inquiry before definite conclusions can be drawn concerning them.

#### SUMMARY

Exportmental evidence has been obtained to show that antirinderpest nonreactor immune sera are definitely protective to Philippine cattle, if used in adequate amounts. Mild reactor sera, or those derived from cattle which had developed a thermal reaction of 40° C, or lower for three days or tess, when given in the dosage of 10 to per 100 kitos body weight protected only one of five test animals; but marked reactor sera, or those derived from cattle which had developed a thermal reaction of 40° C or higher for four days or more, when given in the same dosage protected six of seven animals.

Evidence has been obtained to show that the liter of a reactor serion varies in direct proportion to the degree and duration

of the thermal reaction of the serum producer.

Hyperimmunization was observed to cause an appreciable increase in the titer of a marked reactor serum whose liter was allowed to lapse or of a mild reactor serum; but such effect was not apparent in marked reactor sera of undiminished titer.

Hyperimmune sera used in the dosage of 10 cc per 100 kilos body weight protected all of the four test animals, but in the equivalent dose of 5 cc they failed to protect in four of eight tests

# 1). SERUM OF VACC.NATED ANIMALS AND THE EFFECT OF VIRUS ON ITS POTENCY

Rak.zaki (1925) and Daubney (1928) demonstrated by ordinary simultaneous inoculation tests in susceptible animals that sern of vaccinated animals possess some protective value against rinderpest virus. These results were, however, obtained from apparently infective vaccines. Whether similar results can be obtained from the use of a completely inactivated rinderpest vaccine may thus be determined by the following experiments. Likewise, the effect of virus inoculation into animals vaccinated with such vaccine may be studied.

# EXPERIMENTAL DATA

#### VACCINE SERA

Experiment 1.—Vaccine serum 2200 was obtained from buil 2260, which was vaccinated with 5 cc of chloroform-treated rinderpest vaccine, 5 144, blanch 8, 1983, and bled for serum March 17, 9 days after vact. nation. (Control Dulepri carabae 90 which was received with 10 cc of S-144 and injected with 2 cc of fresh virulent blood 2 weeks rater, developed no reaction to the virus.)

Bull 2726 was injected samultaneously with 300 or of vaccine scrums 2260 (140 or per 100 kilos body weight) and 2 or of fresh virulent blood. This animal developed a severe rindorpost reaction and was finally killed for vaccine.

Experiment 2.—Vaccine serum 2232 was obtained from bult 2232, which was vaccinated with 20 or of S-144 Morch 1, 1932, and bled for sarum March 10, 9 days after vaccination

Bull 2722 was injected simultaneously with 300 cc of the above sering (160 cc per 100 kilos body weight) and 2 cc of fresh virulent blood. This animal developed a severe randerpes, reaction and was family killed for vaccine.

Experiment 2.—Vaccine serum 45 was obtained from Didupiri carabae 45, which was vaccinated with 200 or of chloroform-treated vaccine, 3-165, October 18, 1933, and bled for serum October 28, 10 days after vaccination (Control Didupiri carabae 1284 which was likewise vaccinated with 10 ee of S-166 and inoculated with 2 ee of fresh a culent blood 2 weeks later, developed a temperature reaction but recovered.

Buil 2817 was injected simultaneously with 1 500 ce of vaccine serum 45 (670 cc per 100 ki as body weight) and 2 cc of fresh virulent blood. This strimet developed a severe rinderpest reaction and was family at led for vaccine.

Experiment 4—Vaccine serum 70 was obtained from Dalapies carabac 70, which was vaccinated with 200 ce of chloraform-treated vaccine S 160 November 20, 1933, and bled for vaccine scram December 9, 10 days after vaccination. (Control Dalapies carabac 66, which was likewise vaccinated with 10 ce of S-169 and inoculated with 2 cc of frish virulent blood 2 weeks later developed a temperature reaction but recovered.)

Bull 2014 was impreted simultaneously with 2,000 ee of vaccine serum 70 (760 cc per 100 kilos body weight) and 2 cc of fresh virulent blood. This unimal developed a severe rinderpost reaction and was finally killed for vaccine

# VACCINE BERA (PLUS VIRUS)

Experiment 5 —Vaccine acrum 3409 (plus viens) was obtained from bull 3409, which was vaccinated with 10 cc of glycerine-formolized rinderpest vaccine September 24 1934; inoculated with 1 ec of fresh virulent blood October 10, developed no reaction to the virus, and finally was bled for scrum November 5, 26 days after virus inoculation.

B.ill 3523 was injected simultaneously with 103 cc of the above serum (40 cc per 100 kilos body weight) and 1 cc of fresh viculent blood 3495. This animal developed only a high thermal reaction for 2 days. (Control buil 3459, which was inoculated with 1 cc of virulent blood 3495, developed a severe rinderpost reaction, and finally was killed for vaccine.)

Experiment 6.—Vaccine serum 3510 (plus virus) was obtained from but 3510, which was vaccinated with 0.5 g of dried rinderpost vaccine October 24, 1934; inoculated with 1 ec of fresh virulent blood November 7; developed no reaction to the virus, and finally was bled for serum November 29, 22 days after virus inoculation

Bull 3503 was injected sumutaneously with 94 ee of the above serum (40 ee per 100 kilos body weight) and 2 ee of fresh similant blood 3514. This animal developed a high thermal reaction for 6 days and recovered. (Control bull 3586, which was insculated with 2 er of virulent blood 3514, developed a sovere rinderpost reaction and finally was killed for vaccinal.)

TABLE 4.—Summary of experiments.

E	No.	Shiteylel used. Vaccine scrops No.	A mount	Dell No.	Results where visus (specificals.
-			`		
	3 4 5 6	2050, 2135 45 20., 20.9 (plus vers) \$210 (plus vers)	900, 000, 000, 000, 000, 000, 000, 000,	2726 2722 2813 2914 3273 8500	Solver sinderped searcing.  Do.  Do.  Do.  Lio.  High thermal rection for Z days.  High thermal reaction for K days.

#### COMDIENT

The results of experiments 1 to 4 show that completely inactivated but potent renderpest tissue vaccines were unable to
produce sera of demonstrable protective value against rinderpest virus. It is thus evident that the type or degree (?) of
immunity developed by such vaccines is quite different from
that engendered by an infective one, or another that may contain living virus in subinfective doses. The presence of un
modified active rinderpest virus in the tissue vaccine, therefore,
may be looked upon as superfluous and a source of danger for
the infection that it may produce in some vaccinated animals;
for without such active virus the vaccine still retains its full
immunizing property.

On the other hand, the results of experiments 5 and 6 dem onstrate that the inoctlation of living rinderpest virus into vaccinated animals, even if "no reaction" resulted from such inoculation, was invariably followed by the production of an "immune serum" of definite immunizing property. Similar results were observed it other experiments not included horein. Likewise the results obtained by Kakizaki (1925) and Daubney (1928) on vaccine sera apparently fall in the same category.

Thus, the most question of whether the renderpost tissue vaccine owes its immunizing property to a dead or to a subinfective dose of living virus has been partially answered by the preceding experiments. Certainly its inability to produce an 'immune serum' makes it evident that such vaccine does not contain an animodified living rinderpost virus.

#### SUMMARY

Experimental evidence has been obtained to show that a completely inactivated runderpost tissue vaccine was unable to produce a serum of demonstrable protective value. However, the inoculation of living rinderpest virus into vaccinated animals, even if "no reaction" resulted from such inoculation, was invariably followed by the production of an "immune serum" of definite immunizing property.

# III THE SPLEEN AND LYMPH GLANDS OF RINDERPEST RECOVERED ANIMALS FOR IMPLICATION

The efficacy of vaccines prepared from the spleen and lymph glands of rinderpest-infected animals (killed at the height of the disease) by proper inactivation of the virus with chemicals or by desiccation has been demonstrated by many investigators (Kakizaki et al., 1928, Kelser et al., 1928, Jacotot, 1932, Robles and Generoso, 1933; and others). Yet, whether such vaccines owe their immunizing value to the inactivated or dead rinderpest virus or to other substances contained in the organs used is still a matter of conjecture.

Jacotot (1932) demonstrated that avirulent blood, peritoncal fluid, and abomasal mucosa obtained from rinderpest-infected animals do not possess any immunizing value. Hence, he believes that the vaccinating property of certain organs is not due to the virus but to a "fragile substance" which can be stabilized by dehydration or treatment with chemicals. substance is inoculated it fixes itself to the cellular elements sensitive to the rinderpest virus; its rôle is thus purely passive. Saceghem (1988) calls this substance a "toxin," which he believes to be transformed into an anatoxiu (toxold) by the addition of formalin. Koser et al. (1928), being unable to obtain any ummunizing value from blood rich in rinderpest virus, likewise suggest that the immunizing principle contained in certain organs is "either some biproduct of the reaction between tissue and virus or rinderpost virus that has been changed in some particular way by the activity of the solid tissues." Boynton (1935), on the other hand, believes that a tissue vaccine, like the rinderpest vaccine, apparently owes its immunizing property not to the killed virus, but to a "modified living virus" (modified by chemicals) that has lost its disease-producing power but still retains its ability to stimulate antibody formation in the animal body.

All of the above presumptions are apparently based upon mere inferences from negative experimental results. The reason is

obvious, and as long as we keep on using composite tissue vaccines and are unable to cultivate in pure culture the virus of finderpost, the true nature of the immunizing substance in the vaccine will remain indeterminate.

Nevertheless, an attempt will be made in the following experiments to demonstrate whether or not the spleen and lymph glands of rinderpest-recovered cattle possess any immunizing value (active or passive).

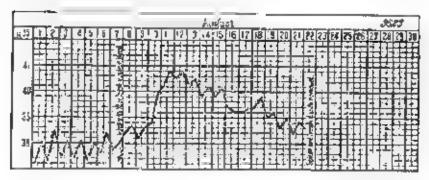
#### MATERIALS AND METHODS

# EXTRACTS OF SPLEEN AND LYMPH GLANDS FROM RUNDERPERF-RUCOVERED ANIMALS

No. 1259. Fuga bull 3250 was vaccinated with 0.5 g of dried rinderpest vaccine September 19, 1934, incomated with 1 ee of virulent blood October 3; and finally developed a tight thermal reaction for 3 days (October 7 to 9). The spicen and lymph glands were removed November .1, 33 days after virus inoculation.

No. 11th (hapennemonized).—Fuga bull 3:03 was vaccinated with 10 cc of glycorine formolised r inderpost vaccina September 27, 1984; inoculated with 1 cc of fresh virulent blood October 10; developed a high thermal reaction for 6 days, and was hyporimounized with 4,000 cc of fresh virulent blood November 7 and a similar amount November 14. The apleen and hymph glands were removed December 10, 26 days after the last massive virus injection.

No. 2625 — Fuga bull 3623 (fig. 12) was acculated with 10 et of virulent blood August 7, 1735 and subsequently developed a high thermal reaction for 6 days (August 10 to 15). The spices and lymph glands were removed August 22, 15 days after virus records on (6 days after the temperature had dropped below 40° C).



Pos. 13: Transmissive effects of sinderposit-spectrum field where refere and county giants.

where were not in the properation of imple extent 3620,

230——2

vs., s.; Fug.; boll 647 (fig. 13) was injected simultaneously with 10 ce of hyperinem me acoust and 2 cc of virulent blood August 14, 1855, and subsequently developed a high thermal reaction for 5 days (August 18 to 22). The upless and ymph glands were removed August 28, 14 days after virule invadant in (5 days after the temperature and dropped below 40° C.).

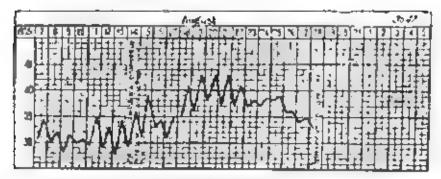


Fig. 4.1. Country is one of an offen property reconcised light relation is prompt and tyrophe abundances of an entrant in.

No 40.7 Leading tool 1977 (fig. 13) was rejected simultaneous with 10 or of aminute session and 2 or of virolant blood Sept under 25-1935 and subsequently developed a tight thermal continuities I days (September 29 to October 2). The appearance symph glands were removed October 10, 15 days after a rus in order and (7 days after the temperature had deepped to 40° C.).

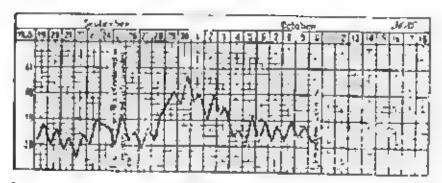


Fig. 14. Temperature exact of conterps treatmental hell where motern and trough wheels were used in the preparation of seven autors 1862-2675.

An. 1861—Rombins bull 2001 (fig. 15) was injected samultaneously with 19 or of immune serino and 2 or of resulent blood September 2a, 1935 and subsequently develope 1 a high taxonal reaction for 4 days (September 30 to October 3) and discribed for 3 days. The veloce and lymph glands were removed betwhen 10, 23 days after virus inequiation (7 days after the temperature had dropped to 40° C)

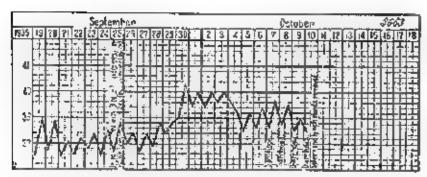


Fig. 15. Temperations of single perturbation of bulk whose soften and byenge games.

#### PIDEPARATION OF ORGAN EXTRACTS

The splcen and lymph glands that were removed from each animal were trimmed of their fat and fascia, disinfected with 5 per cent phonol for 10 minutes rinsed with water, and cut into this slices. Those were steeped overnight in sterile physiological saline, which was subsequently discarded so as to remove whatever traces of immune serum or finds were present in the tissues. They were then ground in a meet chopper, triturated in a mortar, and strained through 18-mesh wire gauze. To the strained pulp distribed water was added so as to make a 20 per cent suspension. The mixture was then shaken thoroughly with glass heads and stored at 0 to 3° C. for 24 hours, after which it was filtered by trituration through 50-mesh wire gauze. The filtrate obtained was a thick reddish brown liquid, and the residue that was discarded consisted largely of connective-tissue capsules and trabeculæ

#### METHOD OF TESTING THE ORGAN ENTRACES

Susceptible cuttle were subcutaneously injected with 500 cr of the freshly prepared organ extracts (containing approximately 80 grams of tissue pulp) and then inoculated with 2 cc of fresh virulent blood in their simultaneously or 7 to 54 days later. Animals that developed a clinical rinderpest reaction accompanied by distribute were declared to have had a severe rinderpest reaction, and those that had only a thermal reaction or no reaction were recorded.

#### EXPERIMENTS AND RESULTS

Experiment 1.—Organ extract 3250 was rejected in 500 cc amounts into Mindoro bulls 3522 and 3515. The former was inoculated simultaneously with 2 er of virulent blood and the factor 7 days later.

Both of this above animals developed severe randerpest reactions.

Experiment 2—Organ extract 3403 was injected in 500 cc amounts into Fuga builts 3579 3576, and 3577. These amounts were inoculated with 2 cc of virulent blood, simultaneously, 10 days fator, and 21 days later, respectively.

The first two annuals developed severe underpest reactions while the det cionculated with virus 21 days later) developed only a high thermal reaction for 2 days.

Expersion 3.— Irgan extract 3623 was needed in 500-cc amounts into Rombian bulls 3657 and 3654. The former was inoculated simultaneously with 2 cc of virulent blood and the laster 14 days rater.

Had 3657 developed a severe renegrest reaction, while No. 3654 developed only a low introduction for 5 days.

Experiment 4 -- Organ extract 3647 was injected in a 500-ce amount into Rombion but) 3648, simultaneously with 2 % of virulen, blood

The above animal developed a severe rinferpest reaction

Experiment 5.—Organ extracts 1060 and 3615 etre pooled and no culated in 500 et amounts into Puga back 3500. Total, 3507, and 3681. The first two were inoculated with views 14 days later and the ast two 54 days later.

Bulls 3500, 3560, and 3507 developed a high thermal exection for 3, 4, and 3 days, respectively. Bull 368° leveloped a severe randerness reaction.

			- 41	
ľ	Yaperiment Degen- No. M	estentia Manner of seet a	g v/(ä )   154/3 No	Trends after virus inoculation
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,	2	2:03 Ten days later	éá	570 l3o,
	_	2.03 Twenty one day	ndana 35	577 Figh thermal court an for 2 mays.
	3	3083 Semulaneously	36	Sie bevere rindergent reaction.
	3	2023 Faurtoro days is	ter 16	Cid. Low thereast reaction for a days.
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		3473 do	35	160 High thremal reaction for 4 days.
		3675 Pifey-four days I	1-1 33	Ar Bigh thermal muerten for 2 day -
ı	5 3663	36/35 die	16	All Severa rindusprist reaction

TABLE 5 .- Summary of experiments and results,

# COMMERT

The results of experiments 3 to 5 show that the spicen and the symph glands of rinderpest-infected animals were no longer virulent on the fifth or seventh day after the temperature had dropped below 40 C, 11 to 15 days after virus incentation (text figs. 12 to 15). This behavior is quite similar to that of the blood,

for Ward et al. (1914) record a rinderpest case whose blood proved noninfective on the thirteenth, fifteenth, seventeenth, nineteenth, and twenty-first days after virus modulation. Tadd (1930) likewise states that the appearance of rinderpest virus in the blood seems to coincide with the period of fever and disappears normally with the subsidence of temperature. However in spite of their noninfectivity, the same spleen and lymph glands demonstrated some immunizing power, provided that an interval of at least 7 days was allowed to slapse before a test dose of virus was given; but not when the virus was inoculated simultaneously.

The behavior of the immunizing substance contained in those organs is thus similar to that of an antigen but unlike that of antipodies; and it seems to diminish quite rapidly after an acute rinderpest infection, as organs obtained 14 to 15 days after virus moculation (experiments 3 to 5) indicated a higher protective power than those obtained 26 to 33 days later (experiments 1 and 2). It may be presumed, therefore, that the antigen concentration in the spicen and symph glands of rinderpest-infected animals is at its highest 6 to 7 days after virus inoculation, as tissue extracts propored at this period have been commonly observed to give the best results. Resides, such antigen seems to be either a residual "changed virus" or a "reaction product" (a toxin as suggested by Saceghem) between virus and tissues, but obviously not an 'unmodified living virus." otherwise the inoculated animals would not have been susceptible to the test dose of virulent blood (experiments 1 to 5).

#### SUMMARY

The spleen and lymph glands of rinderpest-infected animals, 5 to 7 days after the subsidence of temperature below 40° C, or 14 to 15 days after virus inoculation, were no lorger virulant. However, extracts prepared from them and injected in 500-cc (20 per cent emulsion) amounts were able to protect four of five test animals when followed by virus modulation 14 to 54 days later, but when simultaneously injected with virulent blood, they failed to show any protective value.

The immitrizing substance contained in the spleen and lymph glands of rinderpest-infected animals seems to be some form of antigen, which disappears quite rapidly after an acute rinderpest reaction, as organ extracts obtained 26 to 33 days after virus modulation protected only one of three test animals, when followed by virus 7 to 21 days later.

#### ACKNOWLEBGMENT

The writer wishes to thank Drs T Topacio and J D Generoso, chief and assistant citef of the Veterinary Research Division, respectively, for their encouragement and generous attitude towards the pursuance of these studies

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# ILLUSTRATIONS

#### TEXT FIGURES

- Fig. 1. Temperature chart of normal a serum producer 3000.
  - 2. Temperature chart of mild reactor arrup a reducer 3585.
  - 3 Temperature chart of mild reactor serum producer 2652.
  - 4. Temperature chart of mild reactor secum producer 3259.
  - 5 Temperature chart of marked reactor serum producer 3566.
  - 6. Temperature chart of marked reactor securi producer 3600.
  - 7 Temperature chart of hyper minute securit produces 3641 (former y producer of marked reactor security, TR-3541)
  - Temperature chart of hyperamuma servan producer 2586 (formerly producer of an d reactor forum, TR-3566)
  - 9 Temperature chart of hypermanune serum producer 3408 (formerly producer of marked reactor serum, TR-3403).
  - 10 Temperature chart of hyperamoune serum producer 3566 (former y producer of starked reactor serum, TR-3566).
  - Chart showing the affect of hyperimmunisation or the titer of autorinderpost resetor minutes are (see Tables 2 and 3).
  - Temperature chart of rinderpest-recovered bull whose spicer and lymph glands were used in the preparation of organ extract 1923.
  - Temperature chart of rinderpost-recovered will whose splant and lymph glands were used in the preparation of organ extent 3647
  - Temperature chart of randerpeat-recovered bulk whose appear and lymph glands were used in the preparation of organ extract 3663-3675.
  - Temperature chart of rederpest-recovered bull whose spleen and lymph glands were used in the preparation of organ extract 3663-3675

# IMMUNITY IN RINDERPEST-VACCINATED ANIMALS

By T. Torachi and M. M. Romes

Of the Birran of Annual Industry, Maxilo

Rinderpost immunity after vaccination appears to nave been first studied by Kakizaki (1925), who demonstrated that the serum of vaccinated animals apparently possesses some profective value when inoculated into susceptible animals. This was confirmed by Daubney (1928). On the other hand, Robles (in this issue) failed to verify such finding when he used a completely inactivated dried tissue vaccine, but he indicated that the serum of vaccinated animals acquires a deficite immunizing property when vaccination is followed by virus

However, no reference is available to show that cellular immunity after modulation of rinderpest-tissue vaccine has ever been investigated. Thus, it is the object of the present study to determine whether or not the cells of the lymph glands of rinderpest vaccinated animals possess any power of destroying or neutralizing the virus of rinderpest.

The possibility of such behavior has been suggested by the work of Levaditi (cited by D Herelle, 1924), who after passing vicetinia virus many times through the brains of rabbits obtained a true "fixed" vaccinia virus which causes a fatal meningitis; however, if such a virus is introduced into the brain of a previously vaccinated rabbit, it is quickly destroyed, so that after some bours it can no longer be demonstrated. Levaditi has thus shown that "it is the susceptible cells which acquire the immunity and that this immunity is due to the fact that these cells are able to destroy the virus."

Since the announcement by Besredka (1927) a decade ago that immunity may be established without the obligatory participation of antibodies, a field was opened which culminated in the investigation of various mechanisms in the immunity involved in various infectious diseases. In the light of this new concept same of the most important recent advances in vaccine therapy have tended to converge into Besredka's theory of local immunication. Vaccination against vaccinia, smallpox, fowl pox, foot-and-mouth disease, and anthrax may be cited.

The results of his classical experiments on authrax cut-immunication, the oral vaccination against dysentery and typhoid, and the application of antivirus dressings on the skin against the staphylococcus and streptococcus infections were far-reaching and deserve further confirmation or repudiation before we pass apon them lightly. Intradermal immunication against anthrax with the spore vaccine is now an accepted fact, and hundreds upon thousands of animals in Europe and America have already been vaccinated by this method with good results.

More recently Gochenour et al. (1935) reported that in the testing of the various types of anthrax vaccine produced in the United States by commercial houses the intradernal spore vaccine administered in 0.5 cc doses has given the most endaring immunity. Lakewise, it is widely known that immunity in rapies vaccination, whether with virulent or killed fixed virus, is generally followed by the ability of the vaccinated animals to resist subdural injection of virulent fixed brain virus, showing again the specific immunity conferred on the nerve cells. Such cellular immunity has been observed in other infections, but the above list suffices to demonstrate the existence of this limit unity mechanism.

# MATERIALS AND PROCEDURE

Vaccinated animals.—Cattle and carabaes were vaccinated intramuscularly on the left side of the back just behind the shoulder blade with varying amounts of dried rinderpest vaccine as follows:

Day 1 1 th warms	S.
Poga belt 3553	9.5
Puga bull 3556	1.0
Fuga bull 3558	1.0
Fuga bull 3680	5.0
Fuga bull 3684	6.0
Dalupiri carabao 1489	2.5
Dalopiri carabao 1412	10.0
Dalopiri earabao 1492	10.0

Two weeks after vaccination, when immunity was already established, the animals were subjected to intragland that inoculation of virulent blood

Technic of intraginabilar views modulation—The vaccinated animal was properly restrained on an operating table. The right precrues, lymph gland was exposed by a cutaneous incision and careful dissection. One-half cubic continueter of fresh citrated virulent blood was then introduced into the gland substance by means of a 23-gauge hypodermic needle. The point

of inoculation was immediately cauterized with a hot spatula so as to avoid the escape of blood outside the gland. The skin wound was finally sutured and the wound dressed with sterile vaseline or other-collodion. All animals that received the intraglandular virus inoculation were isolated and observed for two weeks.

Testing the virus-infected gland. Twenty four hours after virus inoculation the lymph gland was dissected out, trimmed of its connective-tissue capsule, ground finely in a meat grinder, triturated in a mortar with 100 ec of sterile distilled water, and filtered through a double thickness of gauze. The filtrate was then injected subcutaneously into susceptible animals. These were also observed for two weeks, and if not infected were released for the final susceptibility tests.

Testing the scrum obtained after intraglandular virus enoculation.—Sera from four vaccinated animals were obtained fourteen days after the intraglandular virus inoculation and tested for their protective value against rinderpest virus in highly susceptible cattle.

#### EXPERIMENTS AND RESULTS

# EXPERIMENTS ON THE VIEWS-INFRECTED GLANGS

Experiment / —flul 3553 was vaccinated February 26, 1935, and rereved 0.5 or of fresh virulent blood introplandularly two weeks later. There was no reaction to the virus. Its gland extract was injected into Fugs bull 3548, but no evidence of infection appeared

Control—Ball 3569 (unvacenated) was inoculated in the same manner with 0.5 er of the blood used above. Its grand extract proved infective to Puga bull 3545.

Experiment 2.—Bulls 3555 and 3568 were succimited March 27, 1935, and both were incumited intraglandularly with 0.5 et of virtlent blood two weeks later. As a result the former developed no reaction and the latter showed a marked thermal reaction for five days followed by recovery. The gland extract obtained from bull 3565 was injected into Rambion bull 3681 (2a) but proved assimilated while the gland extract obtained from bull 3558 proved infective to Rombion bull 3568 (2b).

Experiment 3.—Fuga builts 2680 and 3684 were vaccinated October 23, 1935 and inoculated atraglandularly with 0.5 cc of blood four weeks later November 26) neither developed a reaction to the virus. Their gland extracts when injected into Fuga bulls 2674 and 3677 respectively, proved available.

Experiment 4—Daluper carabas 1409 was vaccinated September 18, 1935 and inoculated intraglandularly with 0.5 cc of fresh virulent blood two weeks later at developed a high thermal reaction for five days but recovered. Its pland extract when injected into Fugu bull 3081 proved infective.

Control -The gland extract from Dalapiri extabzo 1407 (unvace bated), which was treated in the same manner as No. 1409 proved infective to Fuzz bull 3679

Experiment, 5. Dalupiri Arabaos 1402 and 1412 were necessated October 33, 1935 and modulated entraplandularly with 0.5 cc virusent blood four works later (November 26). developed no reaction to the virus. Their gland extracts when rajected into Fuga butts 3667 and 3666, respectively, proved avirulent.

TABLE	1 Sammary	01	catterinteries.	1	ta	۵
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Ì	Experie   mont   No.	Test animal No.	Glosd No.	Type of gland	Keradi efter gland og falli nort spa	f could be on the second of sendent blood	u <b>ė</b>
					·		
	1 '	3949	3555	Encolouies	Not infected	Typical nederace	- 1
		3545	3568	Control	Introducti	•	- :
	24	363a	3555	Vacchuzed	New anderson	4)4	-
	2ь,	3633	+ 9558	. 60	Infected		
	1826 .	8674	3596	. de	Nort infected	12e.	
	31⊳	8677	2584	_ de	i do	On-	
	4	4681 j	- 1409	do .	Infected		
	ı	au19	1407	Costreit	ela		
	Sm. ,	5567	7402	Vaer eated	Not inferred	Do	
ш	ep,	1665	4.2	da .	do	100	
_			1				

<sup>\*</sup> Developed the days of thermal reaction after intraglandular sizes (integliation

# EXPERIMENTS ON THE SEREN OSTAINED AFTER INTRACLANDONAR VIRUS INCOLLATION

Experiment d.—Figgs buils 3680 and 3684 (in experiment 3) were vaccinated alctober 23, 1035 and absoluted with fresh varient algod four weeks later (Novomber 26); neither developed a reaction to the virus. Lecember 10 each of these animals was bled for server, which was separately expected, in 200 ec amounts together with 2 cc of fresh virulent alcold into Fuga bulls 3680 and 3682, respectively. Neither of these an male developed, any reaction showing that the serum was protective.

Experiment 7.—Dolopin carabaos 1402 and 1412 (a coner ment 5) were vaccinated October 23, 1935 and modulated with fresh virilent blood (and works later (November 26)), norther developed any reaction to the virus December 10 each of these animals was bled for settin, which was separately injected in 200-ec amounts together with 2 ec of fresh virus ent about into Fuga bulls 3691 and 3695, respectively. The former failed to develop a reseason to the virus, while the latter, No. 3695, which was injected with the serum of Dalupir earnbao 1412, developed a severe rinderpost reaction.

Control.—Figs buil 3.50, which was inconlated with 2 se of fresh virulent blood used a experiments 6 and 7, likewise developed a severe ribuserpest reaction.

#### COMMENT

The virulent blood introduced into the lymph gland in the preceding experiments may be divided into two parts; namely, residual and circulating. The first, as its name would indicate,

remains in the gland substance, while the latter goes into the general circulation

As shown by the infectivity of lymph grands from unvaccinated animals (controls), there remains a sufficient amount of residual rinderpest virus in the gland after a lapse of twenty-four nours. This is true for both cattle and carabaos. But in the lymph glands of vaccinated animals such residual virus appears to have been completely or partly destroyed. The destruction was complete when the vaccine immunity was of a high order, as in the vaccinated animals that developed no reaction to the intraglandular virus inoculation; or incomplete, when the immunity was of a low order as in the animals that developed a thermal reaction (see experiments 2b and 4). It appears that the degree of cellular and local immunity present in the lymph glands may be taken as a measure of the general immunity established in the animal.

It should be noted that all test animals that were not infected by the lymph gland extract inoculation later proved to be susceptible to rinderpest. This behavior suggests that all traces of residual virus (sufficient to cause "inapparent infection") have been disposed of and completely destroyed by the glands

On the other hand it will be noted that the serum of vaccinated animals apparently does not contain antiviral bodies. This is shown in experiments 6 and 7, wherein the inability of the animal to destroy the circulating fraction of the inoculated virus led to the production of an "immune" serum. These results confirm the work of Robles (in this issue) that the seru of vaccinated animals possess no protective value

In view of the preceding considerations, we are led to believe that the immunity induced by vaccination with completely inactivated rinderpest tissue vaccines is largely, if not wholly, a local ceilular immunity which resides in the lymph glands and perhaps in other lymphoid organs of the body. Since immunity in vaccinated animals is not permanent and the fact that the serum obtained from them does not seem to have any demonstrable protective value, it appears that immunity in these cases may be either a simple forthed passive immunity or a very low degree of active immunity.

#### SLMMARY

Experimental cuidence has been obtained to show that the lymph glands of cinderpest-vaccinated cattle and carabaos possess the ability of neutralizing the cinderpest virus in vivo.

This may be taken as a measure of the degree of general im-

mounty produced in the animal body.

The immority induced in vaccinated animals appears to be purely local and cellular in character, as shown by the ability of their lymph glands to neutralize the virus completely when it remains in those organs. The lack of protective value of the serum of vaccinated animals sustains the belief that a humoral immunity is not operating. It is very likely a form of fortafied passive immunity or a very low degree of active immunity, which resides in the lymph glanus and other lymphoid organs of the body.

The serum of vaccinated animals does not contain antiviral bodies. This was indicated by its inability to neutralize the rinderpost virus that gained entrance into the circulation and thereby permitted the production of a protective "immune" serum.

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# STUDIES ON THE CERCARICIDAL PROPERTY OF THE SERA OF VERTEBRATE ANIMALS

By Marcus A. Tubangut and Victoria A. Martiestan Of the Burgan of Science, March

One of the most recent contributions to our knowledge of the properties of the normal sera of vertebrate animals is that of Culkertson and Talbot (1935) or the antagonistic action exhibited by some of these fluids against the cercanial stages of trematode parasites. According to these writers, the cercanicidal test would be usuful in the determination of the complete cycles of these larval forms if evidence could be obtained to show that a relatiously perists between the cercanicidal power of the serum of an animal and the resistance of that animal to infection with a given cercanal. The present studies were undertaken partly for the purpose of extending the observations of Culbertson and Talbot and partly in order to inquire into the probable mechanism of the cercanicidal action.

# MATERIAL AND METHODS

Two species of cercaria were used in the experiments; namely, the cercaria of the blood fluke Schistosoma japonicum, and Corcaria madimensis Tubangui 1928. Only mature actively swimming larvae were utilized in the tests. Larval specimens of C. maitimensis were obtained by exposing infected smalls [Pila lazonica (Reeve)] in the sun for a few minutes in order to stimulate the parasites to crawl out into the water. In the case of the cercaria of Schistosoma japonicum the smalls [Schistosomo-phora hydrobiopsis (Rensen)] were crushed in order to interate the larvae.

The serum samples were obtained from the following: Man, monkey, cow, carabao, sneep, goat, cat, rabbit, gumen pig, chicken, frog (Rana vitt.gera), and fish (Ophiocephalus striatus). Bach serum was used either in the fresh or inactivated state and either pure or dilute. The inactivation was made by heating at 57° C. for 20 to 30 minutes on a water bath. In the prep-

<sup>\*</sup>Received for publication June 5, 1936.

aration of serum dilutions ordinary artesian well water was employed instead of physiological salt solution, for it was found that some corearist were very susceptible to salt solutions.

In carrying out the tests a volume of water containing the cercariae was mixed with an equal volume of pure or dilute serum in a deep hollow slate or a small concave dish. The results were read after one hour incubation at 37° C. A serum was considered to possess cercaricidal property if after the period of incubation the cercariae were found either dead or morph and and much deformed. The result of each test was checked by using a control consisting of a suspension of cercariae either in water or inactivated serum. In many instances it was possible to fore-tel that one was dealing with a potent serum by the sheading of the tails of the cercariae soon after being placed in contact with the serum. In negative tests the larvae remained actively metile and normal in appearance at the end of the observation period in both the test and the control fluids.

# CERCARICIDAL TESTS

The results of the cercaricidal tests are summarized in Table 1, which shows that the various sera, with the exception of those of the cat and the rabbit, possess some destructive effect on the two species of cercaria used in the experiments. Against C. maitimensus, a distornid larva, the various sera were only

Taken 1.—Effect of the zero of different kinds of vertebrate animals on the corearm of Schoolsoma japonicum und Cercaria meditinensis.

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i Chicken			2214 T	(3) (2)
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			+ (t 6%)	107

here All contrains leftled as readinged specimend and very much deformed,  $\rightarrow$  name constraint leftled as rendered a existent and very smech deformed,  $\rightarrow$  describe alone and narmal. Fig. where is parenthesian refer to the maximum titles of a neutral narmal in particular appearance of seven-ring.

partially antagonistic. This finding was probably to be expected. considering that this and related corearize do not introduce themselves into the bodies of their vertebrate hosts through the circulatory system. On the other hand, against the cercaria of Solusiosoma japonioum, which is a blood parasite, the cercaric.dal effect was quite marked, although the titers of the different sera varied between appreciably wide limits. The highest-titered sera were found to be those of the fish and the frog, which were potent in dilutions of 1 to 10 and 1 to 38, respectively The titers of the other sera varied in dilutions between 1 to 2 and I to 4. Taking into account these differences and the fact that Schustosomu japonicum is not a parasite of cold-blooded vertebrates but of mammals, it appears from the results of the tests that there is an inverse relationship between the cerearicidal liter of the serum of an animal and the suscent, bility of that animal to infection with the cerearia. The only exception noted is the low titer of the scrup of the chicken, an animal which so far as known is not susceptible to infection with Schistosoma javonicum.

#### MECHANISM OF THE CERCARICIDAL ACTION

Our findings agree with those of Cultertson and Talbot to the effect that the substance in the scrum responsible for the corcarioidal action is destroyed by heating and is quickly lest by the scrum in storage. The fact that these are also characteristics of that component of the blood known as the complement suggested the probability of the corcariodal reaction being analogous to the bacteriotytic and other cytolytic phenomena exhibited by normal scra. For this reason another set of experiments was carried out in order to inquire into the probable mechanism of the reaction. The results of the experiments are given in Tables 2, 3, and 4.

The results presented in Table 2 show that a serum like that of the guives pig, which has lost its cerearicidal activity by heating, may be reactivated by the addition of a small amount of fresh potent serum. It is deduced from these results that the phenomenon involved is a "cereariolytic" reaction due, according to Ehrlich's side-chain theory, to a combination of antigen, amboceptor, and complement. In the experiment cited, the cerearicidal power of the gumen-pig soulm was apparently lost due to the destruction of the complement by heating, but was restored when a very small amount of fresh guines pig serum was added. Identical results were obtained in paralle, tests made

with human serum. Table 2, however, also shows that the reactivation of the heated serum was not accomplished when the fresh serum of either the eat or rabbit was added due to the fact that the sera of these two animals were found deficient in complement. By titrating these sera against an animonkey bemolytic system, as developed by Schöbl and Monserrat (1917) in the complement-fixation test for syphilis, it was determined that the titer of their complement was less than one-tenth of that of a normal guinea pig

Table 2 —Probable mechanism of the cercuricidal action ride of companiest.

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	Inactivated guara-pig serion and firsh rabbit series, equal cores. Inactivated guinal pig serion and from a ration, equal party				,		
				_			

Table 3 shows that the sera of the cat and the rubbit failed to show any corearcadal effect even when the amount of complement was increased by the addition of fresh guinea-pig serum. This observation gives the indication that the sera of these two animals are also deficient or are completely tacking in amboreptor.

TABLE 3.—Probable machinem of the stroute dat act, who role of umboreptor.

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	fear-dyated rabbit no um		-	
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- 1	Dilute, fresh gusken-qën verum "1 (10)",			1
,	Prosb can serum and dilute fresh guines-pig section 1.5 , equal poets			
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TABLE 4.—The recognicidal liter of the scrum of a number ung infected with Schistosoma papearens can pared with the liter of the scrum of a normal games pig.

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		14 15	L:R	1 13	1:16	1.24	tas	
Nacmal Infected	‡	<u>  </u> 	÷		÷	+		

If the contention is correct that the cercaricidal property is analogous to the bacteriolytic, hæmolytic, and other cytolytic properties of the blood, then like the latter it chould be subject to certain immunological processes. That it is is shown by the results of an experiment, the purpose of which was to find out if an increase in the amboceptor content of the blood could be brought about by infecting animals with Schistosoma japonicum. Of the two animals used, namely, a guinea pig and a rabbit, the latter unexpectedly died three weeks after it was exposed to the cercarne for which reason its serum was not tested. The guinea pig, on the other hand, survived and began passing schistosome ova in its fæces on the forty second day after it was exposed to the parasite. When its serum was tested, the cercaricidal titer was found to be much higher than that of the serum of a normal guinea pig (Table 4).

#### SUMMARY

Tests were made to determine the cercaricidal property of the sora of different kinds of vertebrates against two species of larval trematodes; namely, the cercaria of Schielosoma japonicum and of C maitimensis Tubangui, 1928. All the sera tested, except those of the eat and the rabbit, possessed marked cercaricidal action against the cercaria of Schielosoma japonicum. On C. maitimensis the effect was only partial.

The cercaricidal titers of the different sera against the cercarra of Schistosome japonicum varied within appreciably wide limits. The titers of the sera of mar, guinea pig, and other warm-blooded vertebrates which are known to serve as favorable hosts to the adult parasite, were found to be uniformly low, white those of the sera of cold blooded vertebrates that are not susceptible to be parasite were much higher.

The cercarmidal (cercariolytic), bucteriolytic, hamolytic, and other cytolytic properties of the blood are probably analogous phenomena due to the union of the corresponding antigens with

antibodies of the third order and complement. The fresh normal sera of the cat and the rabbit possess no certaricidal property, due probably to a deficiency in both ambodeptor and complement.

The cercaricidal inter of the serum of a guinea pig infected with Schustosoma japonicum was found to be much higher than that of the serum of a normal animal belonging to the same species, due apparently to an increase in the amboceptor content of the blood as a result of the infection.

#### ACKNOWLEDGMENT

We wish to acknowledge gratefully our indebtedness to Drs S. A. Francisco and A. Dasmariñas, of the Bureau of Itea.th for supplying us with snails (Schistosomophora hydrobiopsus) infected with the cercar.a of Schistosoma japonicum: and to Dr. Jose Ramirez, of the Bureau of Science, for titrating some of the sera used in our studies for complement.

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# NOTES ON PHILIPPINE LINGUATULIDS (ARTHROPODA - PENTASTOMIDA)

By Marcon 4. Touringer and Victoria 4. Massionban
Of the Burens of Science Manda

#### THREE TEAT PICURES

According to Hill (1934), more than fifty species of linguatuleds or tongue worms, have been described from different parts of the world. Only two of these have been recorded from the Philippines; namely, Armillefor monitiformis reported by Tubangui (1924) from the reticulated python and the civet eat, and Alofia travassosi reported by Heymons (1932) from an unknown host (probably a crocodile) in Samar Island. Recently there were added to the parasitological collection of the Philippina Bureau of Science three representatives of this group of parasites, the identity of which is discussed below.



Fm. L. Linguardia acresia Francisch, adult female entre wordt verkich view LINGUATULA SERRATA Francisch, 1739. Text Sa. 5.

A single adult female specimen of this tongue worm was received from Dr. M. V. Santlago, who states in a letter that it was coughed out by a dog in Ajuy, Hoilo. The body of the parasite is of characteristic shape, possesses about ninety abdominal segments and measures as follows. Length, 50 millimeters; width near anterior end, 9 millimeters and at posterior end 2 millimeters.

The adult form of this parasite has been found in man and in the dog and other carmiveres in different parts of the world, and the nymphal stage has been found in man and various species of herbivorous animals. RAILLISTIELLA AGCOLER, NOV. Test for A.

This linguitalid is named for Mr Antolin Ageo, of the Fish and Game Administration Division, Bureau of Science, who cat-lected severa, adult female spetimens of the parasite from a cobra. Compared with the other members of the genus Ra lacticilla which have been reported from snakes in the Orienta. Region, it appears to bear the closest resemblance to R. orientatio (Hett, 1915), a parasite of the Indian snakes Zamensis mucosus and Naja tripadians. It differs from the latter in the following respects: It is smaller and the number of its abdominal rings is less, the maximum being thirty-five. In R. orientalis the miniber of rings is forty or more.

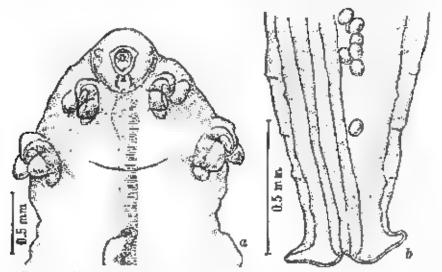


Fig. 2. Italifietella apodi en more, a amerijas und, ventral viero, b. pos crias und, ventral vent

Description—Body of adult females slender, gradually tapering towards posterior end, 16 to 39 millimeters long (average length 28 millimeters). Cephalotnorax more or less conical 1 as to 1.65 by 1.25 to 1.70 millimeters in size. Mouth ventrosubterminal, surrounded by a suckerlike prominence and provided with a distinctive oral armature representing the pharyax Hooks (inequal, arranged in trapezoidal formation, with strong) recurved distal extremities and each surrounded by three ventral projections that are characteristic of the genus Redictivities Anterior pair of hooks smaller, 210 to 305 microns long, posterior hooks 285 to 400 microns long. Two other vesical at

projections are found on the dorsal surface of the cephalo.herax on a level with the anterior pair of hooks.

Abdoner, with thirty-two to thirty-five annulations; terminal segment divided into two divergent lobes, between which is the anal opening.

Uterovagina in the form of a simple see—Genital opening median, at anterior and of abdomen, 1.25 to 1.65 millimeters from posterior border of mouth. Eggs 99 to 100 by 76.5 to 84.5 microns in size.

Host.—Cobra (Naja naja philoppinensis).

Location, -Lungs.

Locality.—Cabanatuan, Nueva Ecija, Luzon

Type specimens.—Philippine Bureau of Science parasito.orical collection, No. 473.

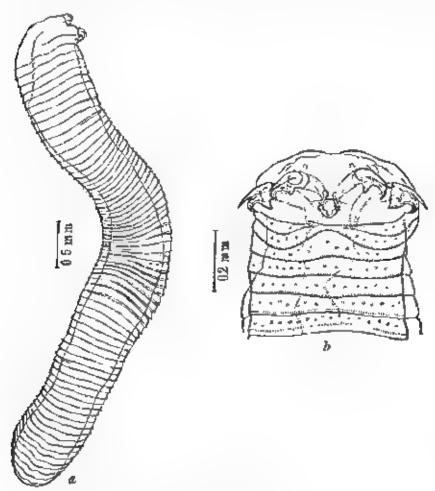
### PENTASTOMUM SOLARIS so, new, Test Sc. 5

This linguatehed is represented in the collection by several immature specimens of tailed from the lungs of a crocodile. It is characterized by the presence of an accessory hook on each of the two pairs of principal hooks and of minute spines on the posterior borders of the abdominal rings. According to Hett (1924), these characters represent tarval features that are usually thrown off at the last ecdysis during the course of development of this group of parasites.

The parasite bears some resemblance to Pentasionam gracile, which, according to Samkon (1922), is probably an immature form of Leopena observatis. The possibility of its being a developmental stage of Alasa travasses should be kept in mind in view of the suspicion of Heymons (1932) that the final host of A. travasses is probably a Philippine crocodile.

Description.—Body cylindrical, rounded at both extremities, 3.5 to 21.5 millimeters in length by 0.6 to 0.8 millimeter in maximum diameter. Cephalothorax small, 0.22 to 0.54 by 0.50 to 0.75 mill meter in size. Mouth ventral, on justement hook line, in small specimens 0.17 to 0.23 and in the largest specimen 0.44 millimeter from anterior end; oral armature horseshoeshaped. A pair of papillse present, one on each side of mediar line in front of anterior hooks. Hooks unequal, disposed archivise, each with a massive root and an accessory spine; unfarior hooks 0.19 to 0.50, posterior hooks 0.20 to 0.60 millimeter long.

Abdomen distinctly annulated, with ninety to one hundred twenty rings; in some specimens lateroventral grooves or lines are present. Each abdominal ring is provided with a circlet of very minute spines on its posterior border and numerous small openings or stigmata that are usually arranged in a single row near the center of the ring.



For 3 feminate-man accords up, now, at entire worm lateral view, h, anterior and, wentral view

Alimentary tract slightly sandous; and posteroterminal Host.—Crocodile (Crocodius peresus).

Location .- Lungs.

Locality.-Palawan.

Type specimens -- Philippine Bureau of Science parasitological collection, No. 476.

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# ILLUSTRATIONS

## TEXT FIGURES

- Fft. I Laguatula serveta Fragile's adult female, entire worm, ventral view
  - Rasilieric la agest sp. nov. a, anterior end, ventral view; b, postorior end, ventral view.
  - Pentantomum solars sp. nov; s, entire worm. lateral view; b, anterior and, ventral view

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# A REVIEW OF PHILIPPINE PIGEONS, IV SUBFAMILY DUCULINÆ

## By CANOTO G. MANUEL

Of the Fish and Game Administration, Bureau of Science Manda

### ONE PLATE

The nature and the scope of the present paper are similar to those of the previous numbers of this series. In this paper the subfamily Duculine comprises the genera Ducula, Myristicitora, Ptilocolpa, and Zonophaps. These are large Philippine Columbida, distinguished from other forest-inhabiting pigeons of the same size by their under tail coverts, which are slightly, if ever, longer than their toes.

Specimens in the collections of the Agricultural College and of Mr. Moises Villaluz, both in Lagina Province, of Mr. Graciano Castañeda, of Pasay, Rizal Province; and of Mr. Carlos Esperancilla, of Sagay, Occidental Negros, were examined in addition to those in the collection of the Bureau of Science. I wish to express my obligations to these persons for their cooperation. The races reported from the Archipelago but not examined in this study are enumerated but not discussed in this paper.

## Key to the Philippine genera of Dacidine

a . General color					Myristic vora
# General color	of myderbart	is not who	le.		
6. Underpares	everpt under	tad cover	ts uniform	ly gray	Duonia.
6 % Underparts	not uniform!	v grav			
e - autom fir	68 U		and the same of the same of		Хоноркара,
c". Bronst gr	ny and chest	ret ,	+ +- +	mrn n.	Ptriocolpa.

## Genus MYRISTICIVORA Reichenbach, 1852.

General color creamy white with wing quills and distal half of most tail feathers slaty black. First and second primaries slightly accoped in their inner web.

One race is known in the Philippines.

## MYRISTICIVORA RICOLOR BICOLOR (Scopolals,

Columba bicolor Scoroll, J.A. Flor. et Paun. Insubr. 2 (1786) 34 Carpophaga casto Peals, U.S. Explor. Exped Mammalogy and Ornithology 8 (1848) 204.

Carpopunga Unolor Casses, U.S. Explor, Exped Mammalogy and Ornithology (1858) 265, pl. 28. Myristicurora bicolor Walden, Team Zool, Soc. London 9 pt 2 (1875)

Myristicivora bicolor bicolor Hachtelea, Birds Philippine Islands 1 pt. 2 (1902) 204

Balabac, Bantayan, Bungau, Cresta de Gallo, Guimaros, Maampa, Marindaque, Masbate, Mindanao, Mindoro, Negros, Nipah, Palawan, Sakujok, Sibay, Sigmjor, Sulu, Tawitawi, Ticao, and West Bolod.

Specimens from Bantayan, Mindoro, Murcielagos, Palawan, Polillo, Siquijor, and Ticao were examined.

Vensorements of Myritalizaria bicolor breater (Scopoli) based on four males and fire females.

	Egyechnys.	Mean.
	Mary"	martin.
Wing	227 439	233.0
Tail	124-135	130.6
Culmen	22-23	22 23
Taraus	30-32	31.33
M diffe toe with claw	44.46	44.4

The material studied from widely separated islands shows uniformity indicating the existence of only one race in the Philippines. According to Hachisuka (1932) the Philippines represents the northeastern range of this subspecies. Chasen (1935) records its occurrence in several islands of Malaysia

## Gerus BUCULA Hodgson, 1936

General color of upper parts, except head and neck, largely metallic bluish green; head, neck, and underparts pearly gray or pale vinaceous fawn. Inner web of first primary slightly attenuated

McGregor and Worcester (1906) recorded six species for the Philippines. Two species with seven subspecies were recorded by Hachisuka (1932).

In this paper the genus is treated with two species grouped into eight subspecies. D a glancocouda is described as a new race.

## Key to Philippine species of Ducula.

- Upper parts metallic bluish green, under tail coverts chestnut.... wass
   Upper parts metallic bluish gray, under tail coverts gray preferrings
   DUCULA ZNEA ZNEA (Linness)
  - Corpophaga wate Guillemann, Proc. 2001 Sec. London (1886) 270. Muscod your succe McGrecon and Worcester, Hand-List Reeds Philippine Islands (1906) 21.

Ducala ware anon Hackisuxa, Birds Philippine Islands 1 pt 2 (1932) 194.

Bungae, Solo, and Tawitawi.

No specimen has been examined in this study.

## DUCULA JENEA CHALYBURA (Synaparie).

Carpophaga chalybura Bonaratte, Coasp. Gen. Av.um 2 (1854) 32 Carpophasa soma Walber, Trans Zool Sec. London 2 pt. 2 (1876) 215

Carpophaga michalir Cabants, Jones. für Orn. (1882) 126.

Museudicora maca McGazgon and Worcesten, Hand-List Rieds Philippow Islands (1906) 11

Moscodirora anchalis McGazzon and Worcesten, Huna-List Birda Philippine Islands (1906) 11

Museaditores chargiera McCrescon, Manual Philippine Bertle pt. I (1909) 43.

Muscadieores wars dialghura Racutsona, Contrib. Birds Phil ppines. No. 2 (1930) 146

Ducada waca chalybura Hacunge Ka, Bleils Philippine Islands 1 pt. 2 (1982) 194

Bantayan, Eastlan, Bohol, Camiguin N., Calayan, Catanduanes, Cebu, Dinagat, Fuga, Gunnaras, Lubang Luzor, Marindique, Mindanao, Amdoro, Negros, Panay, Samar, Semirara, Sibayau, Siguijor, Tablas, and Ticao.

Specimens from Bantayan, Basilan, Bouol, Camigum N., Calayan, Cebu, Fuga, Luzon, Mindanao, Mindoro, Negros, Pamy, Politlo, Samar, Siquijor, Tablas, and Tiemo were examined.

Measurements of Ducula search charging at (Romanus te) based on twenty for specimens of each sex

	ELECTRONICS,	MI ecuts.
Wing	232-450	$2.38 \pm 3$
Tail	148-158	150.3E
Culmen	20-22	20.77
Torsits	39-34	22.71
Middle toe with claw	46-50	48,63

Caban's (1882) described Carpophaga (— Duald) wach also on the basis of the capreous chestnut maps of specimens from Luzon—Harbiseka (1982) considers this character of a seasonal nature and regards unchains as a synonym of chaliphara—Among nineteen specimens in the collections of the Bureau of Science, of the College of Agriculture. University of the Philippines, and of Moises Villetuz from Luzon, seven birds obtained north of 16° north are distinctly chestnut-naped, white eleven of twelve from south of this latitude are distinct in the absence of that churacter (Plate 1). These birds were all collected in April, May, and June. This shows that cause for this difference is not of a seasonal nature. With respect to this particular char-

ì

acter the birds from southern Luzon (south of 16° north) resemble those from Mindoro and Politic. On the other hand, specimens from Samar and Mindonao may, on the basis of this character, be separated from those already mentioned on the basis of a faint trace of chestnut on the nape. The lone specimen from Camarines Sur Province (southern Luzon), however, resembles those from Samar in this character. Until more specimens have been studied, this group of pigeons from Luzon will be regarded as one race

The sheen on the back, which may be bluish green or brown, is a variable character possessed by specimens from the same locality obtained at the same time.

Only one specimen from Basilan was examined in this study. Its tail measures 143 mm, while 148 mm is the minimum tail length of D. a chalybura from other regions. When sufficient specimens (Ducula wave) are studied from this island, they may be found to belong to the typical race.

### DUCULA MUSA PUCATNEIS BARNINGS.

Carpophage macholic Octivit-Grant, Ibia VII 2 (1896) 124.

Museudstern naturals McGamon and Workester, Hand-List Birds Philippine Islands (1996) 11

Muscodiveres suca Inguenus Rachistica, Contrib. Birds Philippines No 2 (1930) 150.

Ducula anna /agarusia Hacutsuka, Birda Philippine Islands 1 pt. 2 (1932) 196.

Ogrivie-Grant (1895) suspected the male bird that Whitehead collected from Fuga to be a distinct subspecies. Hachisuka (1930) named the lone bird in the collection of the Bureau of Science that was collected by McGregor on Fuga as Muscadivores when fugaensis. He used its size as the distinguishing criterion, contending that the wing of this bird is 20 mm longer than that of M. a. chalpbara. Specimens from Calayan and Camiguin in the collection of the Bureau of Science are, in general, larger than D. a. chalpbara from Luzon as shown in Table 1.

## DUCULA ANEA GLAUCOCAUBA BURD NAV

Carpopuaga muca Tweedball, Proc Zool Ser (1879) 832

Minicultivora ance Mc Carron and Workester, Hand L at Birds Philipmae Islands (1966) 1...

Muscadivores chalybara McGnzcon, Manual Philippine Birds, pt. 1 (1909) 43.

Duonta wires chalyburn Hachtsuka, Birds Philippine Islands t pt ? (1982) 194.

TABLE I .- Measurements of D when from the Rabayan group

Seland	Estatogue No. and sea	Wing, 7	THE	Cklimes.	Theston	diddle er and i claw.
Calayan Do Yoo Caraigala Form	9704 &	248 - 248 -	138   134		34   04   24   25	2001 1 49 1 49 48 48

<sup>1</sup> Type of P n. Ingerestic Harbinston.

Six specimens from Samar are similar to one from Biliran and seven from Mindauno (Cotabato, Davao, and Surigao). They are, however, distinct from the other birds studied.

Subspecific characters.—Resembling Ducula whea chalyborn of southern Luzon, Mindoro, Pohilo, Bantayan, Cebu, Bohol, Basilan, Negros, Panoy, Siquijor, Tablas, and Tmao, but with upper surface of rectrices appearing as if covered with a fine gray powder. This substance is also distinctly manufest on the upper surface of primaries and secondaries.

Description -Type adult male, Bureau of Science collection, No 29448; Mount Matutum (altitude about 600 meters), Cotabato, Mindanao, Apr.1 11, 1932; Francisco Rivera, Edge of forehead creamy white, rest of forehead, crown, occiput and anterior maps pale villaceous-fawn, rest of naps with trace of light vinaceous fawn, foreneck pale vinaceous fawn gradually blending into pale olive-gray of hand neck. Back (dorsum, notzum), wing coverts, and rump meta,he bittah green when held towards the light, against a vertical light this color turns to metallic reddish brown. Exposed surface of primaries and secondaries, apper tail coverts and upper surface of rectrices castor gray with an apparent coating of a dawn gray powdery substance that turns to shades between blue and green, depending on its position with regard to the light; sides of head pale vinaceous fawn. orbital rong creamy white; chin creamy white gradually chang ing to pale vinaceous-fawn of throat and rest of underparts except thighs which are mineral gray, under tail coverts bay, under 5 it face of rectrices brownish olive with golden sheen.

Measurements of the tupe -- Wing, 234 mm; tail, 140; culmen, 21, tarsus, 32, middle toe with claw, 44.

In the collection of the Bureau of Science the specimens of this race of imperial fruit pigeon are as follows:

Measurements of Durida when plantositude subsp. nov.

	٠.				1	,	
1	Peresu 4 Science	Per-	I wealisty		! ;	Մկելս	Calledon
;		Feb. 2000 000 0000	Weight Stenar	:	May May Moy June June June Dee May Mar Mar	79, 1924 79, 1924 31, 1924 9, 1925 9, 1925 14, 1027 10, 1921 17, 1921 18, 1921 19, 1921	But MaGregoratof  Do  Do  Do  Do  Do  Do  Do  Do  Do
	19458 19252 25. 59 1590	4118	Monet Statuters, Carobia o cypost statuters,		Apr. Apr. LApr. May.	10 1992   13 1992   12 1992   12 1992   25 1914	1 o flo flo 3. C. Met regor and 3. C. Met regor

Remarks.—All previous workers regarded this bird as Ducua anea chalyburu

## DUCCLA ASSES PALAWASSINSIS (BROW)

Carpophaga were Tweenmale, Proc Zool See London (1878-623) Carpophaga were polawerens's Rubste's, Orn's 4 No. 2 (1888) 316. Museadirora were McGretin and Abscester, Hand-List Birds Phi ippine Islands (1996) 11.

Muscadispres above pain tenesis Ormnossia, L. S. Nat. Mas. Eu i. 139 (1932) 27

Darrilla wien palaminensia HACRISCEA, Birds Philippine Islands 1 pt 2 (1992) 195.

Palabac, Calamianes, and Palawan

Specimens from Balauae, Culion, Linapaenn, and Palawan were examined

Measurements of Ducida wave palewanensis (Hasina) based on some males and may females.

	Exiremen.	M <sub>175</sub> p.
Wing	243-262	248.75
Tuil	156-171	164.48
Culmen	30, 22	21.06
Tarsus	32-33	32.44
Middle Inc with class	44 48	45 84

This race is distinguished from the other Philippine pigeons of the species D. when by its deeper glossy blaish green (dusky dull green) on upper surface of rectness. Generally, the wings

and tail are longer than in other forms, excepting those from Siquitor and Fuga, and some from Calayan and Camigum. Hachisuka (1932) regards Mindoro, Politle, and Tablas as ranges for the present race. Direct chalybore is also considered by him as inhabiting these islands. After an examination of eleven birds from Mindoro, two from Tablas, and two from Politle, I am convincen that the birds from these islands belong to D. anca chalybora.

## DUCULA PICKERINGII PICKERINGII (Carnot

Carpophaga prebringh Cassin, U.S. Explor. Expel Omithology (1882) 267

Miniculiaring p corrings, McGreene and Worderten Paris, List Birds, Philippine Islands (1906) 11

Musicodivores picheringu p everingi: Riley Proc. U. S. Nat. Rus. 77 Act. 12 (1930) 7.

Ducale discretes prebring i Hacil. Suna, Birds Phil pp ne Islands 1 pt. 2 (1982) 197

Cagayancillo, Cagayan Sulu, Sib itu, and Sulu.

Specimens from Baiabac, Cagayancillo, Cagayan Sulu, Calusa, Cavillé, Lumbucan, and Ursula were examined

Measurements of twelve males and ten females (2 not sexed) are as follows:

Measurements of Lucula pickeringa mekeringa (Cussin).

	Exceeding.	Mean ram.
Wing	224-241	231.15
Tail	15275	165.21
Gulmen	18-19	18.71
Taesus	32-34	33.45
Makde toe with claw	40-44	41.8%

This race is distinguished by the creamy white frontal edge of forehead and chin and narrow ring of feathers around eye head and underparts pale vinaceous-fawn, this color gradually changing into gray of head, neck, and mantle, back, including wing coverts, deep mouse gray with a greenish brown tage, wings dark gray with green tage on exposed areas upper surface of tail metallic green, undersurface gray.

#### BI CHEA PICKERINGH LANGBORNEL Greaters.

Muspadivere langhernei Meanns, Proc. Bud. Soc. Work, 18 (1965) St. Muscadiveres prokeringü langhernei Ruzv, Proc. U. S. Nat. Mus. 77

Art. 12 (1930) 7

Ducula enteracea languarnes HAGI ISDRA, Birds Philippox, Islands 1, pt. 2 (1932) 191.

### Bolod.

No ourd of this race has been examined.

DUCULA PICKERIACH PALMASENSIS (Norma).

If uscadivores paintasensis Meanne. Proc U. S. Nat. Mun. 36 (1909) 436.

Municadivores pickeringin paemasonnis Minny Proc. U. S. Nat Mun. 77 Art. 12 (1930) 7.

Ducala cinerasca culmoscusia liacittatika, B rds Philippine Islands 1 pt. 2 (1932) 198.

Palmas Island in Celebes Sca.

No specimen was examined in this study.

## Genus PTILOCOLPA Ronaparte, 1854

First primary attenuated and greatly scooped on middle of its inner web, sexes dissimilarly colored but shade of chestnut dominant in under parts of both.

A monotypic genus confined in the Philipp nes. Three races are known.

## PTILOCOLPA CAROLA CAROLA (Benagarie).

Carponhaga carola Bonaparte, Consp. Gon. Aviern 2 (1854) 34.

Philosolph carola Bonaparte, Consp. Gon. Aviern 2 (1854) 34.

Philosolph generoperies Walren, Trans. Zool. Soc. London 9 pt. 2 (1878) 216.

Philosofpa carola carola HACHISUKA, Contrib. Birds Philippines No. 2 (1986) 151

Luzen Mindoro, and Sibuyan

Specimens from these islands were examined,

Measurements of Philosolph carela carola Bonapurto based on ten makes and fifteen females.

	Fatermes mm.	Mess
Wing	210-221	214.36
Tail	122-136	126.25
Culmon	17 15	17.2
Tarsus	26-27	26.64
Middle too with claw	40-43	41.13

Male.—Head, nape back, and interscapular light guil gray; chin creamy white gradually changing to pale guil gray band of threat. Band bordered posteriorly by a white line which forms the anterior border and the arc of a gray semilinar pecteral area. Lower breast, abdomen, and under tail coverts chestnut flanks gray with impressions of cheatnut on their lower border Except the outer pair, which are yellowish brown with white shafts, the undersurface of the rectrices are black. Wing quilts gray with green gloss. Coverts gray, many feathers with a dark spot at tip; rump glossy green with brown mottles; upper tail coverts and upper surface of rectrices glossy bluish green.

Female.—Differs from the male in having a plumbeous head and nece; interscapulars mottled with plumbeous and green glossed with metal ic copper red; rest of back with more green impressions; no band on underparts; chestnut lighter.

### PTHOCOSPA CAROLA RIDRORUM WEBSHIRA.

Philocolpa nigrorum Westersan, Bull. Brit. Ocn. Club 6 (1891) 34. Philocolpa careta nigrarum Hacutscha, Birda Philippine Islands 1 pt. 2 (1932) 203

## Negros.

I have not examined birds from this locality

## PTILIOCOLPA CAROLA MINDANENSIS Ogliste-Grant.

Philocolpa windenesss Ochlyle-Grant Bud. Rest. Orn. Club 16 (1905) 16.

Philosolpa carola mindanensis Hadinsena, Birda Philipp ne Islanda pt. 2 (1932) 203.

### Mindanao.

Six birds from this island (Agusan and Davao Provinces) were examined.

Measurements of Ptilocolou carota mindanessis Opilvir-Grant based on two mates and four females.

	Platentanen. Pasa	Меко. тип.
Wing	192-208	192.40
Tail	1.6-125	1(9.50
Culmen	16-17	16.60
Tarens		26.00
Middle toe with claw	37-40	39.00

Resembles closely P carola carola, but male has chin and threat white and perforal area grayish black.

### Genus ZONOPHAPS Sulvadoril 1993

Large, bare circumocular area distinct; first and second primaries accoped near middle of their inner webs; tail crossed by a gray band near tip.

Two species and three races were recorded by Hach suka (1932) in the Philippines.

## ZONOPHAPS POSTOCKFUALA POLICCEPUALA (Cray)

Corpophaga poliocephala Gray List Birds Brit, M.is. pt. 3 (Gal.inae) (1844) 6.

Hemiphaga poliocephalo WALDEN, Trans Zool. Soc. London 9 pt. 2 (1876) 217

Carpophaga (Zonophaga) poliocephala Sanvagoni, Cat. Biros Bet. Mus. 21 (1893, 207

Zonophans poliocephala Shanez, Hand-List Birds ( (1992) 65.

Zonophape poliocephala poliocephala Haunisuka Birds Philippine Islands 1 pt 2 (1932) 199. Cebu, Leyte, Lazon, Mindoro, and Panay

Specimens from Lozon and Mindoro were examined

Measurements of two females from Luzon are as follows: Wing, 222 mm, 225, tail, 160, 160 culmen 20, 19 tarsus, 26, 23, middle toe and claw, 47, 47.

Haemsuka's poleraphala does not have a purplish brown sheen on the back. The birds from Mindoro, according to these two birds from Luzon, should, therefore be excluded from this race.

## ZONOPRAPA POLIOCEPHADA NOCHAIS Weckerke.

5 pt. 2 (1932) 20B.

Hemiphago policephula Susert, Trans Linn. Soc London \*1 a.r. 1. Zočiogy (1878) 347.

Zonophaps police phola SHADE, Hand-List Birds 1 (1899) 66. Zonophaps police phola nobilis Hacitistia Birds Philipp ne Islands

Basilan, Dinagat Masbute, Mindanao, Negros, Samar, Situyan, and Tawitawi

Specimens from Basilan, Mindanao, Negros, and Sibuyan were examined

Measurements of Tomophaps poliosephala nolates Hackesula based on three males and ten females

	aSa trentera. Te pr	34 कर क विकास
Wing	217-228	222,25
Tail	155-163	160.10
Calmen	19-22	20.27
Талумя	27-31	27 90
Middle too with clasy	46: 48	47.07

The blids from Mindoro should belong to this race which is distinguished from the typical race by the purplish brown sheen on the back.

### ZONOPHAPS MINDORENSIS (Whitehealt)

Carpunhapa mindorensis Williemead. Ann. & Mag. Nat. Hint. VI 18 (1896) 189.

Zonophops mindoreness Stiater Hand List B eds 1 (1899) 65.

### Mindoro.

I have not examined this species

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# **JLLUSTRATION**

## PLATE 1

Dacate when challinger of writhers and southern Luzon showing color difference of the maps

419

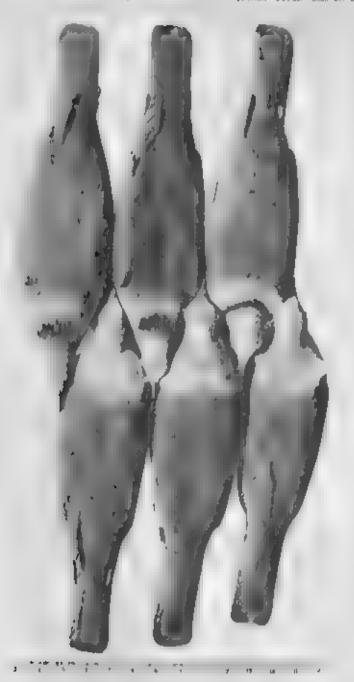


PLATE I

## NEW OR INTERESTING PHILIPPINE SHELLS

By Gudoffeedo L. Algasio

Of the National Museum the stone Bureau of Science, Manual

#### FOUR PLATES

This paper deals with some new or interesting Philippine shells and contains descriptions and figures of three species of shells which have been previously Jesuriord from extra-Philippine material, but are now reported for the first time in the Philippines. It also records an interesting species recently added to the Bureau of Science collection, previously described but not given any definite Philippine locality. Whenever possible original description, type locality, and distribution will be given.

The writer wishes to acknowledge with thanks the valuable suggestions and assistance given by Mr. Florencio Talavera, of the Fish and Game Administration, Bureau of Science, and to thank Mr. Gregorio A. Lopez for his unfailing enthusiasm in collecting and giving the author whatever interesting material he may encounter.

To the list of references on Philippine shells, the following may be added:

28b. H G. Fulton, in the Proceedings of the Malacological Society 22 (1936) 9, described a new species of Courts from Mindoro.

520 In the second series of Phsbay's Manual of Conchology, there appeared descriptions of several Philippine land shells. Four species of the gents Strobuops were given in part 110, pp. 52-56; one species of Gastroopta in part III, p. 120; a list of Philippine Pupillidæ, p. 156.

One of the Occasional Papers of the Boston Society of Natural History is Some new land moliusks from Bornen and the Philippines, by William J. Clench and Allen F. Archer 8 (1902) 87-42, pt 4.

Numbers are those used in the introduction to Bureau of Science Mesograph 25; Surmary of Philipp no Lind shelfs, Philip, Journ. Sci. 42 1932) 85-198, Philippine shells I, Philip Journ Sci. 49 (1932) 543-549.

38. In the Nautilus the following papers or. Philippine shells were published:

Smith, Maxwed, New Phinippine land shells 46 (1932) 62.

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## Family PERNIDÆ Zittel

## Genus PEDALION Solander

(Pozna Bruguiêre)

PEDALION CUMINGE (Beeve). Plats 1, figs. 1 and 2

Perma cumingia Reeve, Conchal Joon 11 (1859) Perma pl 1, fig. 3. Perm testa subarbicular, latere antico baseli producto, crassiuscula, concentrice, rude laminata, radiatum sulcată, laminia subfimbriatia; via a-ceopurpured, fusco tinetă

Shell somewhat orbicular, basal anterior side produced, rather thick concentrically rudely laminated radiately grooved, laminate slightly frided; violet-purple, tinged with brown. Habitat.—Australia, Carang.

The basal anterior side of this shell is but very slightly produced and straight, and maintains almost a right angle with the binge line. The surface is concentrically rudely laminated, the laminar regularly serrated, producing a frilled appearance and also gluing a radiately grooved effect. Violet-purple, tinged with brown with the interior a dark chesput-brown at the borders, and the middle pearly, brownish purple, iridescent. The muscle scar distinct and central

This species very closely resembles P ephippium (Linnaus). Plate 1, figs. 3 and 4, but may be distinguished from it by the nearly straight anterior end with the shell generally thinner and the internal coloration very much darker.

Locality.—Lizon, Manila irreakwater, Bur. Sci. 14635 Alcasid. Attached to rocks and piles by means of a strong byssus.

# Family OSTREIDÆ Lamarck

## Genus OSTREA Linners

OSTREA GLOMERATA Gould. Plates 2 and 3

Ostrao ginaciara Gould, Rusve Conchol. Icon 18 (1873) Ostrao pl. 22, figs. 52a, 5 c. d

Ost testă crassă irregulari, acuticastată, margine dontato vel lobato, vald. "mequivalu, valva superiori operculari, compresso, lam nis crassis concentricis rugată; valva inferiori cuculiată, purpured aut aigro marginată; marginabus lateribus donticulatis cardine pierumque attenuato, praducto, acuminato.

Shell thick, irregular, sharp-ribbed, with the margin dentated or lobed, very inequivalve; upper valve opercular, compressed, wrinkled with thick concentric lamins; lower valve cucullated, purple, white within edged with purple or black, atoral margina denticulated, hingo penerally attenuated, produced, pointed

My specimens are probably immature since they are not very thick and sharp ribbed. The shells are very inequivalved, the lower valve being deep and cup-shaped, and extending far beyond the flat opercular upper valve. The lateral margins of both valves are denticulated to about two-thirds of the entire length from the hinge. Deep purple without, whitish within and edged with purple or black; the upper valve generally grayish within.

The very young spat of this species are spinose, as in Plate 3, and may be confused with O. spinosa; but, as can be seen on subsequent growth, the portion of the mautle that produces the tubular spines later on produces flat foliaceous scales which give it a concentric laminated appearance.

This species was described and reported in the Conchologia Iconica without locality, supposed to have been collected by the Wilkes Expedition.

Locality.—ALARAT, Tayabas Province, Bur. Sci. 14708 Talavera. Minuono, Puerto Galera, Bur. Sci. 14659 Alcasid. Attached in clusters to mangroove roots.

# Family DOLLIDÆ Adams

### Ganus PYRI LA Lamarck

(Fисыа Swainson

PYRULA DUSSUMJERI Valenchances. Plate 4, age, 1 and 2

Purale descentieri Val., Kirker, leonographie des Coquiles Vivientes, Familie des Camilières 8, n. 26, pl. 11; Tayon, Man. Conchol. 7 (1885) 269, pl. 5, fig. 30.

Figure dustrimiers Val. Rente, Conchol. Icon. 4 (1847) Figure pl. 1, fig. 2; Sovemer Thea Conchyl. 4 (1880) 110 Figure pl. 423, fig. 5.

Fic. testă elengato-pyriformi, gracili, spiră subexasetă, liris transversis planodopremia undique cingulată, irarum intersticiia strita longitudinalibus cancellaris; pallidă spadiceă stripia rufofuseescentibus undulatis longitudinalitor pictă, aperture fauco apadiceo-fuscescente

Shell elougately pyriform, slender, with the spire little exerted, encircled throughout with flatly depressed transverse ridges, the interstices between which are contollated with longitudinal string pale fawn colour, painted longitudinally with waved light rufous brown streaks interior of the aperture fawn brown.

Habitot.-Chine, Currenter.

This species is chiefly distinguished from its nearest ally, P. reticulata Lamarck by its more elongated and slender form together with its longitudinal wavy brown stripes.

Typically an inhabitant of the China Sca and apparently

limited to this region.

Locality.--Luzon, Manila Bay, Bur. Sci. 14560 Loper. Colacted with beam-trawl nets in water about 40 to 50 feet deep.

# Family HYDATINIDÆ P.Isbry

## Genus HYDATINA Schumacher

BYDATINA A'd 0-COCTA van der Boeven. Plate 4, figs. 2 and 4

Hydatina albo-e acta van der Hagnen, Reine, Conchol. Icon 16 (1968)
 Hydatina pl. 2, figh 3a & et Angas, Proc. Zool. Soc. (1871) 189;
 Tevon, Mon. Conchol. 15 (1893) 353 pl. 45, fed. 20, 30 Iwakana
 Cat. Jap. Moll. (1919) 16a, Faustino, Bur. Sci. Manog. 25 (1928) 348.

Bulla allowated was der Hoeven, Sawenny, They Conthyl, 2 1850; 560 pd. 120, Figs. 17, 18

Bulla forraginesa Perry, Corchology (1811) pt 40, for 2.

Uvd. testā subglobosa, inflotā tenni semipellucīdu, fusco emeroscente, foscās trībus latas albis radiata et strās obliquis, fuscis, rusierosis, longitudinalibus puch spirā retusa, concavā, uperturā antici amplessinā.

Shall subgloomse, inflated, thin, semipelfueld, brawnish ash-coloured, rayed with three brend while bands, and painted with oblique, brown, numerous longitudina string up to retuse, concave, aperture very wide in front.

Rain at - China, Caman.

The spire of this species is concave, the shell very delicate, covered with a thin, semipellucid, ash-colored epidermis which is fixely as I observely streaked with brown, the streaks interrupted by five sharply defined white bands. Interior white, aperture broadly rounded anteriorly,

Distribution.—China, Cuming; Philippines, Jay, Japan, Iwakawa: Port Stephens, New South Wiles, Australia, Brazzer

Locality —Luzon, Man.la Pay, Bur. Sci 14661 Lope:. Collecter, with beam-travel note in water about 40 to 50 feet deep.

# **ILLUSTRATIONS**

## PLATE 1

Figs. 1 and 2. Pedalion camings Roote.

9 and 4 Pedalion calcipping (Linnens)

Parts 2

Fitta. 1 to b. Ostron glomerata Gould.

### PEATS 3

Fins 1 and 2 Ostron glasserate Gould sput. These are the shells shown in Plate 2, figs. 4 and 5 collected to show tabular appres-

### PLAYE 4

FMS 1 and 2. Parela dassumeert Valenciennes.
3 and 4. Hydatum albo cincta van der Hoeven
274—6

425

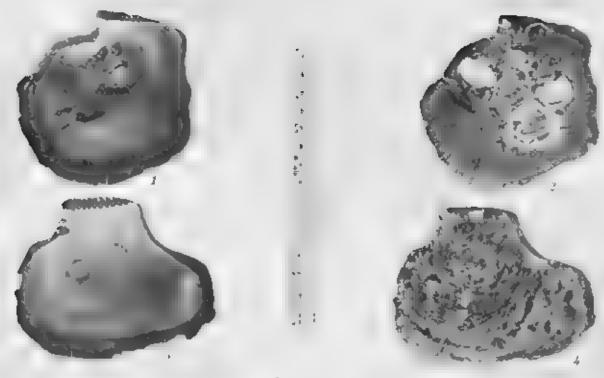
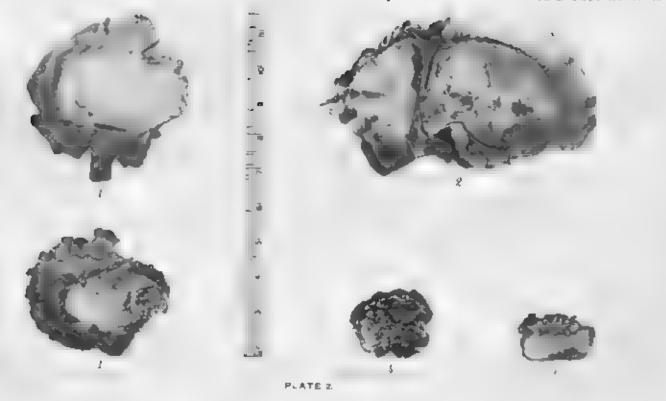
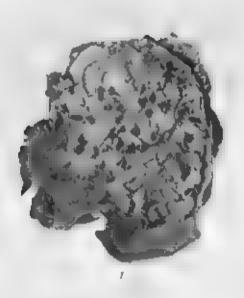


PLATE 1.







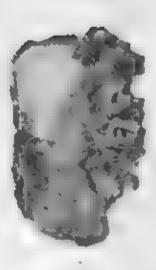


PLATE S.

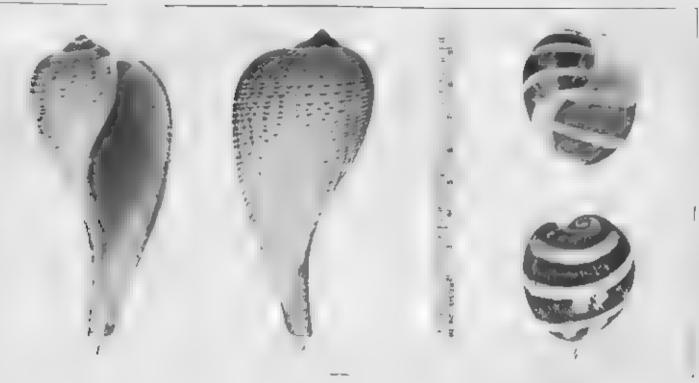


PLATE 4

# THYSANOPTERA OF FORMOSA \

### By RYOICHI TANAHASHI

Of the Department of Agraculture, Roteurch sustitute, Formosa

### FOUR TEXT FIGURES

About fifteen years ago I became much interested in the Thysanoptera of Formosa. Since that time I have given my attention to these insects as opportunity permitted, and the results of my observations on the metamorphosis, biology, and economic status of some species have been published. I have scarcely been able, however, to find time for the systematic study of the group, and many of my specimens have been sent for identification to specialists of this group in this country and abroad, and many species have been recorded from my collections by D. Moulton, H. Priesner, and others

I am convinced that the thrips fauna of the island is fairly well known, and in the present paper an attempt has been made to list all the species now known to occur in the island, with brief biological notes on some of them. Two new species and one new variety are here described.

In this paper musty nine species and three varieties are enumerated, which include some that are hitherto unrecorded from Formosa. There are a few species in my collection not yet identified which are not dealt with here. The food plants given in the following pages are records for Formosa alone.

I am especially indebted to Dr. H. Priesner and Prof. J D. Hood for their valuable help in determining my specimens, and also to Prof T Shiraki for his kind help in various ways.

## TEREBRANTIA

## THRIPIDÆ

### HELIOTHRIPINÆ

## RHIPPROPOURTES PULCHELLUS Biorgio.

Rhepiphorothrips pulchelles Morgan, Proc. U.S. Rut. Mus. 46 (1913) 17; Moutron, Ann. Zoot. Jap. 12 (1928, 288, Pakaitasitt, Iconogr., Insect. Jupon. (1932, 1892.)

Debutsugaku Zassh (Zool, Mag. Tokyo) 35 (1921) 80-86; Botany and Zoology, Tokyo 2 (1934) 1827-1835 Journ Sec. Trop. Agr. Formess 7 (1935) 67-78, etc. Food plant.—Rischofia javanica.

Habitat.—Taihoku.

This species is common on the lower sides of the leaves, which show discoloration of both surfaces. Sometimes occurs in large numbers, and the males are much fewer than the females.

### UELIOTHRIPS BACMORRHODALIS Bearful

Halothrips kamarranianas Boucai, Padennen, Thyran, Enrap. 1 (1926) 126, Tanahashi, Josep Soc Trop Art Formosa 7 (1935-74; Steele, Commorweakh Austr, Counci, for Sci & Indust. Res., Pumph 54 (1936, 16; Rivnay Bull Ent. Res. 26 (1935) 267, Bull. Soc. Roy Ent. Physic (1935) 119, (Other entations are given in Presence's and Takahashi's papers.)

Food plants. Acce a confusa, Acce sp., Alms formasina, Areca categou, Bixa orellana, Camellia thea, Cinnamoni m camphora, Citrus spp., Coffea arabica Codiaeum variegota a, Cunninghamia lanceolata, Diospyros kaki, Gardenia florida, Glochidion spp., Gossypium indicum, Liquidembar formosona, Machilus sp., Moliosma rhogolia, Macsa formosona, Moras olde, Mangifera indica Myrica inbra, Primas spp., Polygonum sp., Quereus variabilis, Rhododeudrou sp., S deroxylon ferrugineum, Terminalia catappa.

Habitats.—Throughout the lowlands, and found also in the mountainous regions (Rimogan acar Urai Habor Mus.ia, Kurasu near Hassensan, Fujieda near Rokki),

This species is very common and sometimes occurs in abundance, causing serious damage. It a tacks the leaves only and at times is mixed with Selenotherps in brocintus Chard, no male has been detected. Blany specimens have been taken on cotton, palm, and Eugenia, at Koronya, Ponape Island (Japanese South Sea Islands).

## REMONDINGS BRUKNEIPENNIS BARRAIL

Mellotierps brunneipmenis Bagmall, Ann. & Mag. Nat. Hist. 15 (19.3) 318.

Helmosturups brunneripamus Bagnalla Ann. & Mag. Nat. Hist. 10 (1982, 506.

Food plants.—Colocusia sp., Nicotiana tabacum Primus sp. Habitats.—Urai mear Taihoku (July 2, 1931), Yusho near Piyanan (August 13, 1934), Taihoku (December 5, 1935)

Hitherto unrecorded from Formesa. The Formesan specimens have been compared with a cotype by Prof. J. D. Hood.

#### MERCINOTERRIS FRRANS WIREARD

\*\*Herolandhvipa errana Withhams. Entora. 49 (19.6) 243; Priesner
 \*\*Thysonop. Europ. 1 (1926) 131; Kurosawa, Kontyn Tokyo 4 (1936) 113; Patesa. Phil p. Journ. Sci. 57 (1935) 351

Food plants—Pranus sp. and a species of the Lauracee. Hantats.—Taiboku, Kabodai near Hassensan, Suisha.

This species is rather common in the mointainous regions, usually being found in small rumbers. It has the nabit of jumping from the host when disturbed, and the males are much fewer than the females. Not yet discovered on the Orchidacea in Formosa, though known to occur on plants of this family in Europe and Japan.

### ASTEROTURIPS ANGULATUS Hood.

Asterothraps augulatus Hoop, Psyche 32 (1928) 50

Food plants.—Againa lutchnense, Ficus sp.

Habitats.—Taihoka, Sozan near Taihoka, Rimogan, Kuraru. New to the fauna of Formosa. My specimens have been kindly determined by Dr. H. Priesner

### SUI ENOTHRIPS RUBBOC, NOTUS GOM.

Schnotterps reproductes Giard, Bu L Sec. Ent. Fr. (1901) 263, fa-Kallashi, John. Sec. Trop. Agr. Formesa 7 (1935) 75. (Other literature is cited in Takahashi's paper)

Food plants.—Acacia confusa, Alms formosana, Bixa orellana Camelius sasanqua. Diseppros kakt. Elacocarpus elleptica, Engena pambos, E. unifora, Giochidron sp., Pranus sp., Quercus rariobilis, Psidum yna, axa. Wendlandia globrata

Habitats.- Throughout the lowlands.

Common, sometimes occurring in abundance, but not yet found on cargo in Formosa, though known as a serious pest of it in some countries. At times found in groups with Heliothrips humarrhoidens Boaché.

#### CHIROTHRIPINÆ

## CHIROTERUPE TAKAMARIHI Megitun.

Getrotherps inkahash : Motorton, Ann. Zoot. Jap. 11 (1928) 289.

Food plants.-Sorphum sp., Miscenthus sp.

Habitets.-Taiboko, Kanodai near Hassensan Kurasu.

This species inhabits the flowers, and the specimens collected are females only.

### ANAPHOTHRIPINÆ

ANAPHOTHEIPS FLAVELINGTUS Marmy.

Anaphothrips flaviouncies KARNY, Bull Jaru Bot. Buitenzorg II 10 (1913) 55, Buil Doli Proofet Sumatra 23 (1920) 24, Revue Russ. Fut. 25 (1933, 174; Priessen, Philip. Journ. Sc. 57 (1935) 355

Food plants. Schurie italien, Sorghum an, and another plant of the Graminese

Habitata.—Taihoku, Urai near Taihoku, Sminten, Mako (Pescadores Islands).

This species altacks the flowers and leaves, and sometimes occars in large numbers on sorghum in the Pescadores Islands.

### ANAPHOTHRIPS THEIPEROUS Rate-

Anaphothrips theimedia Kanny, Treubia 2 (1921) 69; Primanes, Thysia Europ. (1928) 205, Mourton, Ann. Zoal Jup. 11 (1928) 291.

Pood plant.—Unknown in Formesa.

Habitat.—Taihoku

### ANAPROTUCES ORCHIDE Ametica.

Anaphothrips orchidd Moulson, Bur Est. U.S. Dept. Agr., Tech. Ser. 12 (1907) 52, Pinesner, Thysan. Europ. (1928) 204; Moulton Ann. Zou., Jap. 11 (1928) 191 Proc. Haw Est Soc 7 (1928) 197, 132.

Food plant.-Machilus sp.

Habitats - Chikushiko, Sozan near Taihoku.

In Formosa this species is not found on orchids, but feeds on the leaves of the young trees of Macaillus sp. The leaves are rolled along the margin, with the lower surface in.

## SCIRTOTHERS DORSALM Hood.

Secretablips down is Hood Insec Insect, Monst. 7 (1919) 90, RAMA-ERISHNA ANAR, More Dopt Age, India, Ent Ser 18 (1928) 251 RAMAKRISHNA ANYAR and MARGARINDHI JOHN Humbay Nat. Hist Soc 34 (1934) 1024, PRIESNER, Bull. Soc Roy. Ent Egypte (1962) 151, 153.

Food plants.—Araches hypoguen, Mangifera ind.ca, Fragaria chilocusis.

Rabitats.—Tainan, Tathoku.

Sometimes occurs in large numbers on leaves, but not so injurious. Near Ta boku sometimes rather common on the upper sides of leaves of strawberr; plants in December, and found to breed on the tea plant at Ryote, Japan, from where it has not been recorded.

### THRIPINA

### AYVARIA CRETOPHORA Kerey

Apparla chesophora Karni Mom. Dopt. Agr India, Ful Ser 9 (1926) 193; Ramaresenna Avyar, Mom. Dopt. Agr India, Est. Ser 10 (1928) 255.

Food plants.—Glycine, Canaralia, and other Legtimuosæ, and Gongpium indiciam.

Habitais.-Talhoku, Kyakgokudo near Heito.

This species commonly feeds on the lower sides of leaves of cultivated beans, and many adults are seen on the leaves of cotton. Compared with the holotype by Dr. H. Priesner

## FRANKLINFELLA FORROSIAS Manitan.

Prinkhmella formers Moulton, Ann. Zool. Jap. 11 (1923) 291, STEINWEDEN and Moulton, Proc. Nat. Hist. Soc. Fukien Christ, Unix. China 3 (1930, 21 TAKARASEL Iconogr. Insert. Japon. (1932) 1895.

Food plants.—Arachis hypoyaca, Bauhinia sp., Citrus spp, Caermis sp., Cucurbita moschata, Gossypium indicum, Ipamoca batatas, Lagerstroomia indica, Luffa cylindrica, Melastoma candidum. Rasa spp, Saccharum officinarum, Styrox suberifolium, and other species.

Habitats Taiboku, Shinko, Kyuko near Shinchiku, Tosei, Kagi Shinka, Tainan, Takao, Heito, Chippon near Taito

Very common in the flowers of a wide range of plants, but askally very rare on the Graminese. The females much outnumber the males.

#### FRANKUNIEULA GOSSSTPH (SMoski).

Enthops possyph Simbart, Agr Exp. Sta Formosu, Special Rept. 5 (19.2) 65.

Food plant.—Gossypium indioum

Habitats.-Kagi, Hedo.

Closely all ed to F formass Moulton, but differing in the paler, smaller, and less selectized body. Pale yellow, prothorax darker, pterothorax somewhat reddish, abdomer dasky on the apical part. Found in the flowers and on the lower sides of leaves of cotton, while F. formoso blowlon is found in the flowers only.

### TAXABLE PROPERTY OF THE PROPER

Tennitirips infrog. Barning. Ann. & Mag. Nat. Hist VIII 12 (1913) 292 Barnald, Bull. Ent. Res. 9 (1918) 6.5 Mounton, Ann. Zool. Jap. 14 (1928) 301 Barraksiskoa Ayvas, Nem. Dept. Agr. India.

Ent. Set. 10 (1928) 258, STRINWEDEN and MOULTON, Peoc. Nat. Hist. Sec., Fukies Chippt, Univ. Chips. 2 (1930) 23, STRINWARD Trans. Am. Est. Sec. 59 (1933) 282

Food plants. Camellia thea, C paponica Styrex suberifolium. Habitats.—Taihoku, Hoppo Gyochi, Chippon near Taito.

Found only in the flowers, common on Camelou, and a single male has been taken on Styrax.

### TAXMOTHERS VARICORNIS Mention.

Transthrips varieornic Mauliton, Trans Nat. Hist Sec. Formosa 18 (1928) CB2: Takahashi Iconogr Insect Japon (1932) 1873; STERNWEDEN, Trans. Am. Ept. Soc. 59 (1931) 276.

Food plants.—Lutta cylindrica, Mannifera indica, Persen quatussima.

Halitats.-Tarboku, Kagi, Kuraru near Koshun

Very rare in the northern part of the island. Pound only in the blossoms.

### TENIOTHERS DISTALES NAMED.

Two otherips dictable Karny Archiv f. Nature, 79 (1913) 132, Merc. Dept. Agr. Incha. Ent. Sec. 9 (1926) 196, RAMARISHNA AYYAR, Mem. Dept. Agr. Incha. Ent. Sec. 10 (1928) 256; Moulton, Ann. Zool Jap. 11 (1928) 297. Strinweden and Moulton, Proc. Nat. Hist. Sec. Fukien Christ. Univ. China 3 (1930) 26; Strinweden, Trans. Art. Ent. Sec. 59 (1933) 275.

Temothrips losquiryles Karns, Johnn. Siem Soc. 15 (1923) 39, Bull. Ent. Res. 16 (1925) 126. Ment. Dept. Agr. India, Ent. Ser. 9 (1920) 196; RANAKHSHNA AYYAR, Mem. Dept. Agr. India. Ent. Ser. 10 (1928) 258, Moulton Ann. Zool Jap. 11 (1928) 301; Steinweden Troms. Am. Ent. Sec. 59 (1933) 275; McLlaway Prof. 5th Pacific Sci. Congr. Canada 1933 5 (1934) 3441

Food plants. Crotalaria Astragalus, Tephrosia, Phasaolus, Vigna Dolichos Vicue, and other Leguminosa, Nicoliana tabacum, Ipomoca sp. Luffa cylindrica, and other species.

Habitats, Throughout the lowlands of Formosa, and some mountainous regions (Uran near Tathoku, Shikikun near Tatheisan, Kurasu near Hassensan, Matsomire near Saramao, Fujleda near Rokki); Botel Tobugo (Kotosho).

This species is abundant through the year in the flowers of various legumes, but is found in small numbers on other plants. It has not been detected on the leaves in Formesa, though some were observed attacking the lower sides of the leaves of a bean at Nago, Okinawa, Loochoo, April 27, 1930.

The males appear in any season, but are much fewer than the females. In T distals the fore femora and the flurd antennal segment are quite dark, whereas in T. longistylus the fore femora are light in color within and the third antennal segment is at least palor than other segments; but there is recognized no morphological difference between them. Moreover, these two are found together in the same flowers in Formosa, the latter form being the commoner.

Many females belonging to the form longistylus were collected on Tephrosia at Koronya, Ponape Island (Japanese South Sea Islands), August 26, 1933 The species has been known from Figi and Sunda Islands, but not from Ponape Island.

### T#NIOTHRES CLARES Moslion.

Temothrips clarus Moulton, Trons Not. Hist. Soc. Vormosa 18 (1928) 267; Steinweden and Moulton, Proc. Nat. Hist. Soc. Vulkon Christ. Univ. China 3 (1930) 22, Steinweden, Trans. Am. Ent. Soc. 59 (1933) 281.

Food plant.—Raphanus acceptinformis. Habitat.—Tanhoku.

#### TAINIDIGRIPS CANAVALLE Medicon.

Two attrips canavalin Moulton, Ann. Zool Jap. 14 (1928 295; Steinweden, Trans. Am. Ent Soc 59 (1933) 280

Food plant.—Canavalia obtusifolia. Habitat.—Botel Tobago (Kotosho).

### TÆNIGTURIPS FORMOSAL Men ten.

Funishings formane Moulton, Ann. Zool. Jap. 11 (1928) 298, Stein-Weden, Trace. Am. Ent. Soc. 59 (1933) 276.

Food plant.—Canavalia obtusifoka. Hubitat —Botel Tobago (Kotosho).

### TARKITERIES KOTOSHOT Martion.

Tan others kotosho: Moulton, Ann. Zool, Jap. 11 (1928) 209; Stein weden, Trans. Am. Eat. Soc. 52 (1932) 284

Food plant.—Camannia obtusifolia Habilat.—Botel Tobago (Kotosho).

### TEXNOTHERS GRACILIS Naulton.

Fariothres gracula Moulton, Trans. Nat. Hist. Soc. Formosa 18 (1928, 269 Steinwegen and Moulton, Proc. Nat. Hist. Soc. Filkien Chest. Univ. China 3 (1930) 23, Steinwegen, Trans. Am. Ent. Soc. 59 (1933) 272, 283.

Food plant.—One of the Legummose. Habitet.—Taihoku.

TERMOTREMS COUNTICEPS Pricence.

Teniothraps cognitivens Privance, Stylops 4 (1935) 127

Food plants -Torenia conculor, Languas sp

Hubitata.—Shinten, Uras, Rarasan, Sozan, Tameisan, Tarcko, Miharashi and Miyama near Chippon, Chushinron near Rokki,

Very common in the mountainous regions: attacks the flowers. A few specimens have been taken in the Llossoms of Melastoma sp. at Gustiko, Amamieshima, Loecheo.

TAXNOTERIPS OREOTHERAS Promer.

Tanisthrips or cophiles Philaskie, Philip Journ Sci. 57 (1935) 355

Food plants.—Torema concolor and a plant of the Rosaccae Habitats —Rarasan, Taihelsan, Muroruafu, Matsum re Arisan.

Common in the mountainous regions; some specimens were taken at Ubasa, Oita Prefecture, Japan.

TANSIOTREPS OF LEURATUS PROMAC

Twofethrips sulfaratus Priesnes, Philip. Journ. Sci. 57 (1935) 358.

Food plants.—Camelha japonica, Clerodendron sp. Narcussus tazetta.

Habitats -Taihoku, Shinten, Matsumine.

TANIOTARIES SMITHI (Zimperman).

Physiopia smith: Zimmerrag B.D Irst. Rot. Bultenzorg 7 (1900, 10. Tenish ips smith. Steinweisen, Trans. Am. But. Soc. 59 (1933) 283. Priesnes. Phinp. Journ. Sci. 57 (1935) 356

Food plants -Orchids.

Habitats.—Taihoka, Hori.

Always found in the flowers, common at Hori, central Formosa.

TENIOTHRUS ANALLS IN DAY.

Female—Ibrty pale yellow, slightly deeper in color on thorax. Eyes black: occili orange-yellow, dark pink on the crescents. First antennal segment pale whitish yellow, second dusky throughout, third dusky, pale whitish yellow on basal and cistal parts, fourth dusky except on basal small pale part, lifth to eighth dusky, lifth slightly paler on basal small part. Second to sixth abdominal tergites with a broad, obscure, somewhat pale frown band along anterior margin, which is not well defined on hind border, anterior margins of these tergites narrowly brownish except on lateral part and a very thin transverse gray line behind brownish margin. Legs pale yellow,

tarst paler, with tips dasky. Wings pale brown, forewings with a very small, indistinct, clear area behind the forevein near base. Prominent sette on body and wings brownish black Head slightly wider than long, somewhat constricted behind eyes, slightly arched on cheeks, slightly constructed basally, a little protruding anteriorly, and widely and distinctly divided at front end between antennes with some thin, indistinct, transverse strike on posterior part. Eyes slightly protruding, much narrower than vertex, much longer than half length of cheeks, with some curved sets, distinctly divorging on the mesal margins except on posterior part, facets large, six, arranged on lateral margin. Occili closely placed between posterior halves of eyes, as wide as erescents, posterior occili larger than anterior, well separated from eyes, occilar triangle much wider than long; interocellar bristles very long, very stout, inserted between posterior ocalli, very slightly curved, strongly diverging, as stout as postangular bristles of pronotum, in contact with mesal sides of ocelli, about 0.056 mm long. Postocular sette short, thin, nearer to eyes than to cheeks, about 0.014 mm. long, three similar lateral sette behind each eye, two pairs of short than sette also in front of occili, two pairs of very long setse on anterior part of venter of head. Antenna about twice as long as head, a little separated from eyes, first sogment wider than long; second constructed on basal part, much longer than wide, with six or seven very long seta; third narrowest at base, broadest on middle swollen part, constricted on dista) part, 2.5 times as long as wide, with three or four very long setze, and a pair of sensory cones which reach basa, part of fourth; fourth similar in shape to third, about 2.5 times as long as wide, with three very long sets and a pair of sensory cones, fifth a little narrowed towards base, not awollen, constricted basally, twice as long as wide with about four very long sets: which are shorter than those on fourth, sixth about 2.2 times as long as wide, with a sample sense cone arising from about the middle and reaching apex of eighth; seventh as long as wide, narrowed distally, eighth twice as long as wide, 15 times as long as seventh; lengths (and widths) of segments as follows: III, 0 060 mm (0.028 mm); IV, 0.065 (0.026); V. 0.037 (0.018), VI, 0.046 (0.02)); VII, 0.009 (0.009); VIII, 0.014 (0.007). Propotare about 1.7 times as wide as long, near y as long as head, rounded on lateral margin, with rounded corners, hand margin slightly shorter than anterior, with six bristles; over fifty, somewhat curved, rather long setz scattered on pronotom except on a pair of large, median, circular areas behind middle, setze about 0.019 to 0.023 mm long; two setze on anterior angles, curved, as long as dorsal ones, postangular setze very long very stout, pointed, equal in length alout twee as long as median pair of setze on hind margin, about 0.069 mm long; pterothorax a little wider than pronotum, median bristles on metanotum, for separated from anterior margin, a little curved, about 0.51 mm long. Abdomen broadest or middle, a little wider than thorax, second to eighth tergites with two pairs of setze, which are much shorter on anterior segments, median pair of setze on eighth tergite about 0.055 mm long; eighth segment completely set with teeth on hind margin; ninth segment with two pairs of long stout dorsal setze, two pairs of smaller ventral setze and two pairs of long lateral ones, which are longer than segment; tenth segment with two pairs of very



FR. J. Termothrips ander ap-

long stout setz, which are shorter than lateral ones on ninth, but longer than dorsal ones on ninth; postangular bristles long, very stout, pointed, a little curved, about 0 069 mm long on sixth segment; sterrites without accessory setze. Wings reaching eighth abdominal segment, forewings with seven basal and two distal setze on forevein, thirteen setze on hind vein, and twenty-five setze on front margin, which are very stout, mostly a little curved, and those on voins

about 0.050 mm long; one of the marginal sette near tip much thinner; double fringe of hairs not observable in my specimen Legs with many short letx; femora nearly as long as tibux, fore tibite about four times as long as wide. Body about 1.5 mm, head about 0.148 mm long, about 0.162 mm wide, antenna about 0.3 mm long, narrowest width of vertex between eyes about 0.069 mm, pronotom about 0.222 mm wide, mesothorax about 0.286 mm wide fore tibia about 0.16 mm long, lateral bristles (upper pair) on much audominal segment about 0.129 mm long.

Food plant.—Aralia bipimata.

Habitat .- Asahi (Taito-cho).

A single specimen was taken by me in the flower, May 16, 1935. This species is characterized by the very large interocellar bristles and the shape of the front of head. In Steinweden's

key to the species of Tumothrips 1 this thrips runs to group II B, but differs from all the species in it, as well as from all species not included in the key. It is easily distinguished from T. glycines Okam by the colors of body and antenna, the shorter sixth antennal segment, the pale grown wings, the shorter pronount, and other characters. The type is in the collection of the Department of Agriculture Research Institute, Formesa.

#### TENIOTHRIPS ALLIORUM Primare,

Tamothrys alberton Pattisker, Stylops 4 (1935) 128.

Food plant .- Allium fistulosum.

Habitats. Taihoka, Heito; Naha, Okmawa, Loochoo, Common, but occurring in restricted numbers,

### TERIPS TARACI Landmann.

Thrips tabus: Lindeman, Kanny Mom. Dept. Agr. India, Ent. Soc. 9 (1926) 199; Prinance, Thyson. Europ. 2 (1927) 439; Takamashi Journ. Soc. Trop. Agr. Formosa 7 (1935) 76. Steele, Common wealth Auste., Common for Sci. & Indust. Rev., Pamph. 54 (1935) 46. (Other citations are given in Priesner's and Takahashi's papers.)

Food plants.—Allian spp.

Helilats.-Throughout the lowlands,

In Formosa this species is confined to omore, no specimens having been found on other plants, though the species is extensively polyphagous in other countries. It is very common on the leaves and flowers from April to June near Taibokit and much reduced in numbers during winter, no make has been discovered.

#### TARIES FORMOSANUS Pringer.

Therips formosomus Priesner Natuurkand, Tipasaler, v. Nedert.-Ind. 94 (1934) 285.

Food plants—Viola sp., L Lum sp. and other species Habitals.—Ta'he.san, Kiitaka-yama (Mount Morrison). Hinokiyama and Takimi (Takao Prefecture), Izumo (Taito-cho). Common in the flowers on high mounts ps

#### TRRIPS KARNYUNUS PREMIE

Turing horngram's Patesner, Natuurkund, Tijdschr v. Nederf ind. 94 (1934) 282.

Food plant.—Banhusa? Habital.—Naii (Takao Prefecture).

<sup>\*</sup> Trans. Am. Ent. Soc 59, 260.

TERTIFIC ORYLAND Williams

The 24 argam Williams, Rull. Ent. Rev. 6 (1916) 353, Karny, Journ Stam Soc. 16 (1923) 169; Moditon, Ann. Zool, Jap. 11 (1928) 363, Ramaerskina Ayyas, Mem. Dept. Agr. India, Ert. Soc. 16 (1928) 263, Takahashi Iconogy, Insect. Japon. (1932, 1894, Ramaerskina Ayyas, Agr. & Live-stock India 2 (1932) 395. Priesers Nutruck, Tipdachy, v. Nederl-Ind. 94 (1934) 289.

Food plants.—Oryza sativa, Zea mays.

Habitat .- Tarhoku.

Not common, ravely occurring in abundance.

#### TERIOS BAD AHENSIS (Mercan).

Enthrops haven wines Montan, Proc. U. S. Nat. Mus. 46 (1913) 3 Thrips homericaris Phinanch, Natuurk, Tijdschr. v. Nederl.-Ind. 94 (1934) 206.

Tantalarija hawaransis Moulton, Proc. Haw Ent. Soc. 7 (1928) 132; Steinweden, Trans. Am. Ent. Soc. 58 (1933) 286.

Throps albipes Bagnall Ann. & Mag. Nat. Hist VIII 13 (1914) 25; Ent Month Mag. 54 (1928) 151, Ramarkishna Ayyar, Mem. Dept. Agr. India, Ent. Sec. 10 (1928) 261 McClifon, Ann. Zucl. Lap. 24 (1928) 302, Steinweden and Montron, Proc. Nat. Hist. Soc., Fullen Christ, Univ. China 3 (1930) 24

Tantolhrips pallipes Moulton, Ann. Zool. Jap. 11 (1928) 302.

Food plants.—Acaesa confusa, Alliam fistulosum, Carlicarpa formosum, Camelha spp., Citrus spp., Arolia sp., Castanca sp., Clerodendron spp., Circum spp., Chrysanthemum coronarium, Eria nudicaulis, Gardenia florida, Gordonia anomala, Gossyphem indicum, Echinochloa crusqulti, Hibiscus rosa-sincusis H suriacus, Ipomoca batatas, Issimumm sp., Ligustrum japanicum, Litium sp., Luffa cylindrica, Lautana sp., Morus alba, Mallotus spp., Marruna spp., Musa sapientum, Miclastoma candidum, Michelia spp., Miscentius sp., Norium inaicum, Narcissus taxetto, Nophelium Inchi Psidum guajava, Phoenix hanceara, Passiflora sp., Papaver sommforum, Plumiera acuminata Pencedanim japonicum, Raphanus sp., Sansciuria scylanica, Sambucus sp., Saccharum officinarum, Tephrosia sp., Vigno sp., Zen mays, etc.

Habitats.—Throughout the lowlands and some mountainous regions (Urai, Kurasu and Kahodai near Hassenson, Func.ko, Asabi and Kakayo, Taito-cho, Habon near Musha, Fujieda near Rolki); Mako, the Pestadores Islands.

This species is the most dominant and polyphagous thrips in Formosa and is common in Loochoo and Japan. It feeds on a very wide range of plants, including the Grammere, but has not been found on the Gymnosporme or the Orchidaces. The species attacks the flowers only, and is very injurious to the poppy. The males are as common as the females.

THREE PLOBER Schools.

Thomps forms Schmitz, Steungsber Kaisen Akad, Wiskensch, Wien, mathem, anthony. Klasse 122 (1013) 13, Karny Archiv f. Zool. 17 (1924) 13 Ramarchenina Avyar Mem Dopt Agr India, Ret Ser. 16 (1928 201 Rec Ind. Mas. 34 (1932) 2 7; 36 (1931) 493, Philashem, Natural Lijdsche, v. Nederland, 94 (1934) 281, Streez, Communicacità Austr. Committer Ser. & India. Res., Pample 54 (1935) 39.

Food plants.—Citrus limonew, Styrez suberriolium Habilats.—Taito, Chippon. Not common, always inhabiting the flowers.

THROPS CLARUS MUSCION.

Thrips charas Mourrow, Trans. Nat. Hist. Sec. Fermiosa 18 (1928) 294.

Food plants.—Altum testulosum, Bidens priuse, Crenmis, & livus, Cirsium sp., Chrysanthemum coronarum Setaria italier. Ipomoca batatas, Gossypium indicion, Lilium sp., Lantana sp., Mucanthus sp., Polygonum sp., Viola sp., Zea ways, Various k gumes, and other species.

Habitats.—Throughout the lowlands, and some mountainous regions (Chakon near Urai Rarasan, Shikikun near Taiheisan, Kahodai near Hassonsan, Ar.san, Funkiko, Mosha, Marikowan, Hakku, Kotobuki and Izumo, Ta.to-cho, Ilinokiyama, Takao Prefecture)

Very common; usually found in the flowers, but sometimes attacking the leaves of cotton and the flower bads of the Hy.

THRIPS EXPENSIONING Propage,

Threps extensions a Priesser Natures, Tipholo, v. Nesect. Inc. 44 (1984) 276.

Thrips pallages Mottres nec Basmall), the Zool Jap. 11 (1928) 303.

Food plants.—Clerodenaron sp. and a plant of the Composited Habitets.—Taihoku Tansui, Shurn, Daiton-san Not common, feeding on the flowers.

TERMS (ISONEUROTSRIPS) APPENDES Printers

Thrope (Isomerotherps) addeedes Prinsser, Natuurk Podecki v Nederl-Ind 94 (1994) 270.

Food plants.—One of the Compositie, and other species. Habitats.—Shruker Botanwan, Karara, Banro.

Common in the flowers of various plants in the southernmost part of the island, but not found excepters. The males are common. THRUS (ISONBUROTHRIPS) TAIWANUS were, dur-

Hanneurothrips padipes Moulton, Trans. Nat. Hist. Soc. Formosa 18 (1928) 296.

Food plant.-A plant of the Leguminosa.

Habitat .- Hor ..

Mounton's name is preoccupied by Thrips pallines Bagnall

### TERIPS (ISONEUROTREPS) SETIPENNIS Moulton

Throps (Isomeurothrops) scripenius Moulton, Trans. Nat. Hist. Sec. Formosa 18 (1928) 297.

Food plant.-Unknown

habitate - Taihoxu, Botel Tobago (Kotosho)

#### THRIPS IMICROCEPHALOTHRIPS) ABDOMINALIS Constant

Thr.ps abdom sala Crawrord, Pomons, Col. Journ. Ent. 2 (1910), 157; Warson, Florida Agr. Exp. Sta. Bull. 168 (1923) 43

Merrescephatothreps abdominals Bagnall, App. & Mag. Not. Hist, 1X 13 (1926) 114, Moulton Ann. Zaol. Jap. 14 (1928) 307; Stringed Dan and Moulton, Proc. Nat. Hist. Soc., Fukien Christ. Univ. China. 3 (1930) 27, Takahashi Iconogr. Insect. Japan. (1932) 1824.

Thrips (Clerethrinella) addominal's Moveron Proc. Haw. Lat. Soc. 7 (1928) 110, 132

Food plants.—Ageratum convendes, Carysonthemum coronarum, another plant of the Compositio, and a plant of the Leguranosie.

Habitots...-Taihoku, H.emseisan K.nport, Klirun, Tonroka near Umi; Mako, the Pescadores Islands.

# TURIES (FOLKEROLA) SERRATOR (Robot).

Physothrups at cetas kotas, Meded. Proefst. Oost-Java 43 (1892). (Not available.)

Phlorothrips pullidicarus Marst Mura (part.). School a mital Insekt. d. Zuckaraders Formosos (1910) f...

Steadbrips minutes Karva, Zeits wiss Insertential, 11 (1915) 65, Montron, Ann. Zool. Jap. 11 (1928) 307; Tarantushi, Iconogr., Insect. Japon. (1932) 1893.

Throps monitors Isunda Insecta Mats Sapporo 9 (1935) 55.

Thrips (Succharathrips) servedus Priesmes, Nathark Tijdsche v Nederland, 84 (1934) 280.

Food plant.—Saccharum officinarum.

Habitats.-Taikoku, Shinka, Taman, Zenka

Sometimes occurs in large numbers on the leaves and in the flowers, but is usually less numerous than other species on sugar cane.

# 1906H/ETOTHRIPS QUEBCI Morphole.

Isochmtelhrijes querer Moulton, Ann. Zool. Jap. 11 (1928) 367.

Food plant .- Quercus ap.

Habitat, - Taiholm.

# BOLACOTURIES ORTHNEALIS Priemer,

Beiacotherps orientalis Praesnes, Philip. Journ. Sci. 57 (1935, 369,

Food plant.—Alliem feetulosum

Habitat.—Tarhoku.

# PARAMALIOTERIFS TAKAHASHIE Pricents

Parabehethrips takahash i Palesner, Stylops 4 (1986) 125.

Food plant.-Liquidambar formosana.

Habitat, -Kanko near Shinten.

Attacks the lower sides of the leaves,

# PARABALIOTUBIES GRANUICISES Priving

Parabaliothrips grandiscus Patesyra, Stylops 4 (1935) 126.

Food plant.—Querous sp.

Habitat.-Reimer at Hassensan.

# DOCHOOTISHEPS DICTARS Printer.

Doculathraps uniterm PRESNIE, Stylops 4 (1936) 127

Food plant.-Penduem quajava.

Habitat.-Kuraru near Koshun.

# TUBULIFERA

# PHLÆOTHRIPIDÆ

### PHLEOTHRIPINE

#### GYNARIOTRRIPS UZELI Zimmermun.

Gynatiothrips as a Zumerman, Bull Inst. Bot. Buitenzorg 7 (1900) 12; Karry, Contraibl. f. Bakter, Parasitory a. Infektionsky 20 Abted. 2 (1911) 561, Marcedlina 1\* (1912) 129; Hond, Inste. Inset. Menstr. 1 1913) 153, Karry and Textwen, Bull. Jardin Bot. Bultenzorg 10 (1913) 168; Karry and Textwen, Bull. Jardin Bot. Bultenzorg 10 (1913) 168; Karry, Zeite, f. wiss. Insectebbled. 20 (1915) 387; 21 (1916) 89; Takahasht, Trans. Nat. Hist. Soc. Formula 12 (1922) 30, Karry, Trechel 3 (1922) 325, Iourn. Sign Soc. 16 (1923) 145, Warson, Plocals Age. Exp. Std. Bull. 168 (1923) 68 Moulton Ann. Zoo. Jap. 11 (1928) 145; Ramansishna Ayyar and Marcarandur Journ. Botsbay Nat. Hist. Soc. 34 (1931) 1040, Primmer Rev. Zool. Bot. Africa. 22 (1932) 196. Takahash., Bot. & Zool. Tokya 2 (1934) 1829

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Liothers sp. Mass Forest Exp. Sta. Formese, Spec Rept. 1 (1915) 16.

Cambiotherius ap. Tamahashi, Dobuta Zasabi (Zool, Mag. Toky ) 35-(1921) 82

Gynatkolariya Agens Ishida, Directa Mats Suppore 6 (1971) 10 Gyna kolanya sp. Tarahashi, Bot. & Zool. Tokyo 2 (1974) 18 (1

Food plants.-Ficus vetasu, F. swinkee

Habitate—Throughout the lowlands; Mako, the Pesculores Islands.

Very common a. Formosa and Loochoo on Files retusa, colling the leaves. The galls of this species are inhalited by the inquilmes Mesothrips nordani Zimmerman, Amerothrips remarka idra. Karny, Haplothrips mga linus Priesner, Succentivothrips takahasha Moulton, and other species.

#### SMERINTHOTERIUS VITIVORUS Printer

Smerintkolbrips releases Prizzer, Ph. Louine, Sci. 57 (19.5 - 54, Gynaikotkeeps elargement Moutton (see Karny), Ann. Zool Jap. 54 (1928) 308; Ishida, Insecta Mais, Support 6 (1931) 39, Then hasel, Bot. & Zool, Tokyo 2 (1934) 1829.

Gynnikothrips sp. Takananiii. Bot. & Zoud Tokyn 2 (1934) 1828-1832.

Food plant.-Vitis shifuncusis.

Habitats.-Throughout the Jowlands.

This species is common wherever the host plant grows, rolling the leaves; and the galls are invaded by *Haplothrens inquilmen* Priesper.

SHERINTHOTER PS LILIAUX & (Monitors).

Gynnibethrips hillocen Mourron, Ann. Zool, Jap. 11 (1928 - 210, Takawashi, Bot. & Zool, Tokyo 2 (1934) 1832

Food plants .- Smilar spp.

Habitats. Taihoku, Urai, Shinten, Sekatae, Kannonsan, Hori, Kahodai near Hassensan, Daijurin near Shinsulei, Kurara bear keshin.



bate 2. Su erinthotor pe Stores Monting, mall

This species is very common, rolling the leaves and is sometimes found with Smerlathothreps Euvana (Moulion) in the galls. Many specimens have been taken on Smilar at Iriomote, Loothoo. The males are common, but usually less numerous than the females.

# SMER.ATHOTHERPS VUASAL (Mon feet)

Gynnikothrips ymnem Mourron, Ann. Zool. Jap. 11 (1928) 315.

Food plant. Unknown.

Habitat.-Domon near Karenko.

# SMERINTHOTHRAPS KUWAYAMAI (Sloubon).

Gynaskothisja kususyasaa Moulton Trans. Nat. Hist. Soc. Fermosa. 18 (1928) 302

Food plant.—V.burnum arboricolem

Habitata -- Karapin, Koshun

Found on the lower sides of the leaves

# SMERINTHOTRIUPS STAMENAGE (Revay)

Gymaikothrum nicenemis Kakur, Treaton 3 (1923) 349; Journ. Simm. Soc. 16 (1923) 183. Mem. Prept. Agr. India 9 (1926) 236.

Food plants.—Inthocurpus sp., Quereus sp.

Hubitats.—Suisna, Kahodai near Hassensan.

Found in small numbers on the lower surface of the leaves

### SMERINTHOTHRIPS CITRICORNIS (Moulton)

Gynaskothrips edverarie Moltaton, Trans. Nat. Hist. Soc. Formesa. 18 (1928) 300.

Food plant.-Liquidambar formosana.

Habitats .- Ta.hoku, Shirin.

Attacks the lower surface of the leaves.

### SHERINTHOTHROPS TAKADASBII (Modern).

Gyneskothrips takakash'i Musinon, Arn Zool, Jap. 11 (1928) 317, Takahastii Iconogi, Insect. Japon. (1932) 1891; Bot. & Zool, Tokyo 2 (1934) 1829,

Food plant.-Frens relusa

Habitats-Taihoku, Kikamon near Boryo.

Always found in the gales of Gynaskothrips useli Zimmerman, being very common in Formesa and Leeches including Amamieshima.

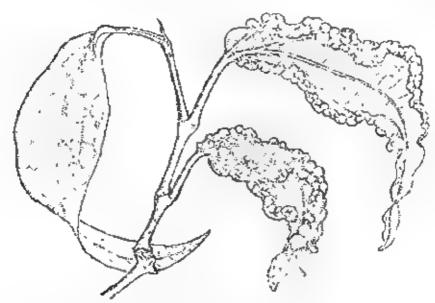
#### SMERINTHOTHUPS Kt WAYAL (Montton ..

Gynaskochriga krammer Moulaon, Ann. Zool. Jap. 11 (1928) 508, Takamashi, Bot & Zool. Tokyo 2 (1934) 1831

Mesothrips clariformus Takamaken (nec Moulton), Iconogr Insect. Japon. 41902 1890.

Food plants.—Piper tutokadsura Smilar china, Smilar sp. Habitats.—Taiboku, Shinton, Schitac, Sozan, Urm, Rarusan, Oryake, near Tosei, Habon near Musha, Daljaria near Shinsmei, Keshan, Kikamon near Boryo, Kuraru, Chippon, Kowarim, Botanwan, Tachibana (Taite-cho).

This species is very common, especially on Piper futokadsura, forming galls on both food plants. Sometimes found associated with Smerinthothrips litracer Moulton in the galls on Smilax while the galls on Piper are inhabited by the Inquilines Liethrips piperinus Priesner and Haptothrips inquilinus Priesner. The galls on Smilax are similar in shape to those of Smerinthothrips litracer Moulton



With 5 Separate Markette Lindowski, (Monday), units

# NEOSMERINTHUTHEIPS FORMOSENSIS Priemer.

Neusmerinthathe ps. jarmesensus Priesner, Philip. Journ. Sci. 57 (1935) 368

hood plant.—Unknown.

Habitats,-Make, the Pescadores Islands.

# LITOTETOTHRIPS HOTENDLE (Montion)

Gunnikalharps retundus Ma. Tron. Trons. Nat. Hist. Soc. Formus: 18 (1928) 204 Ann. Zool. Jap. 11 (1928) 321.
Litotetethrips consumosa Pressess. Tronb a. 10 (1929) 4

Food plant -Ginnamomum camphora.

Habitat.—Tarboku

Very scarce, occurring in restricted numbers in the buds and on the young shoots.

HOPLOTHERPS PUNIOSUS Moultage.

Hoplother ps fungosus Moulton, Trans. Nat. Hist. Soc. Farmora 18 (1928) 405.

Food plants -- Polysticius sp. and other fungi of the Polyporaceæ.

Habitute. Tathoku, Kagi, Ketko near Karenko Somelunes found mixed with Hoplothr.ps juponicus Karm.

RUPLOTHRIPS JAPONICUS (herry)

Develothrips japonicus Karny Archiv f Naturgesch 79 Abted. A (1913) 126, Moulton, Ann. Zoel, Jap. 11 (1928, 550

Food plants Fungi of the Polyporacese.

Habitats — Taineisan, Keiko near Karenko, Chipponsan, Kuraru.

Sometimes occurs in large numbers, grouping with Hoplothrips fungosus Moulton.

HOPLOTERIES (ODONTOPLOTERIES) DENTIFER Prisance.

Hoplothrips (Odontopiothrips) dentifer Priesner, Philip John Sci. 57 (1935, 365

Hoplothrips sp. Takahashi, Bot. & Zool, Tokyo 2 (1934) 1933.

Food plants.—Bladhia sieboldu, Gierodendron sp. Habitet.—Taihoku.

Found associated with Mesothrips claripennis Moulton on Bladkie, and in the flowers of Clerocondron. Also taken at Nishivakama, Amamioshima, Loochoo

CRYPTOTHRIPS MAGNUS Moulton.

Craptolarips magazz Mourton, Trans Nat. Hist. Soc. Formess 18 (1928) 290; Ann. Zool. Jap. 11 (1928) 329.

Food plant.-Unknown.

Habitat. -Kolosko (Botel Tobago).

CRYPTOTURIES SAUTERI RAFRY.

Craptothrips seaters KARN1, Suppl. Ent. 2 (1913) 127, Mayaran Ann. Zool Jap. 11 (1928) 330.

Food plant.-Unknown.

Habitat.—Kankau.

LIOTSKIPS PIPERENUS Priseer.

Linthrips paperious Prusner, Philip. Journ Sci 97 (1935) 361

Food plant.-Piper futokadsura.

Habitata—Rarasan near Urai, Habon near Musha, Chippon, Botanwao.

Always found in the galls of Smer. athothrips knownes Moutton, but in far fewer numbers than the host species

INSTRUMENTAL PROBLEMS IS CONTAINED.

Craptothreps for identity Watson Fat News 24 (1913) 145 28 (1915) 52, Flor de Agr Exp. Sta. Bill 168 (1923) 69, 70 Moule Ton, Arm. Zoo. Jap. 11 (1928) 329

Liothe ps floridensis Warson, Florida Ent. 9 (1925) 39.

Food plunt.—Cinnamomum camphora

Habitat, Taihoku.

In Formosa this species is very scarce, being found singly or in very small numbers on the distal ends of the young shoots or in the leaf buds, nowever, it is very injurious in Florida, North America

#### LOTHERICS LIKES ITT BUS KARNE

Listlema becezischer Karene Maucellie 11 (1917) 156, Takamashi, List. & Zoot. 2 (1934) 1829.

Liethrina melieti Meclifon, Trans. Nat. Hist. Sec. Formas. 18 (1928) 308; Ann. Zool, Jap. 11 (1928) 309; Takanasht, Iconogr. Insect. Japon. (1932, 1891)

Food plant -Mallotus repandus.

Habitats.-Taihoka, Kannonsan, Daltonsan, Tosci, Rokki,

Very common, shrinking the leaves; sometimes project upon by Hoplothrips inquilmus Priesner. The Formosan specimens have been compared with the type specimen by Dr. II. Priesner

LISTERIPS REEVERSUS WARRY VAL. PLAVICURYS Mention.

Look the Intribules Karny var. Remourant Mobility's, Trans. Nat. Hist. Sec. Formosa 18 (1928) 310.

Food plant -Unknown.

Habitat.—Tarboku.

# LIOTHRIPS HEPTAPLEURINUS PRIMING

Lothrips heptaph armus Priesken, Phi ip. Journ. Sci. 57 (1934) 360

Food plant.-Heptapleurum sp.

Hubitat.—Taihoka.

### LIOTERIPS TERMINALIZE Mon ton.

anotheripa terminalise Molliton Trans Nat. Hist. Soc. Formosa 18 (1998) 331; Ann. Zool. Jap. 41 (1928) 332.

Food plant. Terminalia catappa.

Habitat,-Koshan.

# RECYNCHOTHERS (2) MACHILI Montes.

Rhynchoth: ups (7 machill Moulton, Trans. Nat. H st. Soc. Formean 18 (1928) 313.

Food plant.—Machilus sp. Habitat.—Tattana near Musha. DOLLEBOTHERPS FLAVIPES SECTIONS.

Nechesgeria flavines Montron Trans Nat Hist See Formosa 18 (1928) 517

Food plant.—Euphorhia sp. Habitat.—Tatholca.

# DOLICEOTHERS MACARINGAL (Mosters,

vesuregeria macorragai Mollion Trans. Nat. Hist. Soc. Formosa 18 (1928) 310, Takamashi, Jeonoge Insect Japon. (1932) 1889

Food plant. -Mucuronga tanarius.

Hab tats -Tarhoku, Takao

Very common, occurring in large numbers in the flowers and among the bads.

### DOLEROTHREPS PUMILIS Printer.

Dolicha hripa pionolia Priesnen, Phil.p. Journ. Sci 67 (1935) 362.

Food plant.-Diospyros discolor-

Hab.tat.—Nisui

Attacks the lower sides of the leaves.

### PIECTROTHRIPS CONTICINUS Pricence.

Pleatrothrips conficence Priesnes, Philip. Journ. Sci. 67 (1935) 374

Habitat.-Taihoku.

Found under the bark of decayed trees.

#### SERSOTHRAPS TORDAND Zimmerman.

Mesotherps yordow. Zimmerman, Hull Inst. Bot. Buttenzorg 7 (1900) 16, Karnt, Journ. Sign. Soc. 16 (1920) 145, Priesner, Treadin 10 (1920) 452; Takahakmi Bot. & Zool. Tokyo 2 (1934) 1830.

Food plant - Ficus retusa.

Habitats.—Shoka, Gaishatei, Tosei, Nisur, Tainan, Takao, Heito, Daibu.

Always found in the galls of Gynaikothrips uzel. Zimmerman; common in the south part of the island but ausent in the north. The thrips recorded under the name Mesothrips pyotes var debits: Karny, by Moulton, from Formosa, may be this species.

#### MESOTHRIPS ALLUAUDI Vollet

Mesoturius adamen Vuiller Bull. Soc. Ent France 1914 (1914) 211, Muchton, Ann. Zool. Jap. 11 (1928) 319.

Food plant.—Machilus sp. Habitat.—Ta.hoxu

Ann. 2001 Jap 11 (1928) 318.

MASOTREIPS CLARIPENNIS Mechae.

Mesothrips olarspornes Moulton, Trans. Nat. Hist. Soc. Pormosa 18 (1928) 315. Takahashi, Bot. & Zool. Tokyo 2 (1934) 1833.

Food plant. Bladbla sicholdie.

Habitats — Taihoku, Sozan, Kannonsan Also found in Ama mroshima, Loochoo.

This species is common, rolling the leaves. The gails are invaded by Hoplothrips inquilinus Priesner and Hoplothrips dentifor Priesner

# ANDROTHRIPS MAMACRANDRAL Karey.

Andrethrips remechandres Karny, Vem. Dept. Agr. Iodia, Eat. Sec. 9 (1926) 226, Hamaritshna Ayyar, Mem. Dept. Agr. Iodia, Rat. Sec. 10 (1928) 301; Modifion, Ann. Zool. Jap. 11 (1928) 318; Takahashi. Bet. & Zool. Tokyo 2 (1934) 1833

Food plant.—Picus retusa

Habitats .-- Nisul, Taman.

Found associated with Gynaskotarips uzeli Zimmerman

### WAPLOTURISH GOWDEY! Franker.

Hopiothrips gowdcy: Franklin, Proc. U. S. Nat. Mus. 32 (1968) 724; Hood, Insec. Insect. Menstr. 1 (1913) 149; Mem. Queensland Mus. 5 (1918, 127; Watson, Florida Apr. Exp. Sta. Bull. 168 (1923) 60; Moulton, Ann. Zool Jap. 14 (1929) 319; Proc. Hawnii. Ent. Soc. 7 (1928) 125, 134; Priesner, Bull. Soc. Roy Ent. Expte 1929 4 (1929) 216; 1930 4 (1931) 251; Record. Ind. Mus. 35 (1933) 354; Moulton, Bishop Mus. Bull. 113 (1935) 21

Food plants.—Ageratum sp. Allium fistulosum, Aster lauruleanus, Bidens pilosa, Celosia spp., Chrysanikemum sp., Girsum sp., Clerodendrou sp., Cyperus sp., Emilia sonchifolia, Gossypium radicum, Lantana camara, Lactuca debilis, Melastoma candiuum, Oenanthe sp., Osmanthus fragrans, Rubus illecebrosus, Zea mays, and other species,

Habitate.—Throughout the lowlands; the Pescadores Islands. Very common in the flowers of various plants.

# BAPLOTERIPS ACCULATUS Februaries.

Haplothrips acadeatus Fubricius, Philisher, Thysan. Europ. (1928) 507; Megliton, Ann Zool, Jap. 11 (1928) 319, Record. Ind Mus. 35 (1933) 366, Hagnati, Ann & Mag. Nat. Hist. X 11 (1933) 326. Philosothrips palitaleorus Matsunurk (part.), Schaedt, u. nuciz., Irackt. d. Zuckerrobes Formesas (1910) 11.

Philocothrips pullicorum Marsununa, Mem. Soc. Ent. Belg 18 (1911) 138.

Haplothrips pullicornes MOOLFOR, Am. Zool. Jap. 11 (1928) 334,

Food plants -Alliam fistulosum, Colosia argentea, Cyperus sp., Hibuscus rosa-sinenzis, Setaria italica, Miscanthus sp. Oryza satura, Saccharum officinarum, Sorghum sp., Spinacia oleracea, Zea mays, and other species.

Hahltota.—Taihoku, Hokuto, Shinten, Kagi, Shinka, Zenka, Heito.

Common on sagar cane, at times occurring in large numbers, but scarce on rice; always in the flowers.

#### WAPLOTTIKIPS GANGEBAUERI Schmitz.

Haptothrips parallmers, Schmutz Snegsbericht, Akad. Wiss. Wien (1913, 1934; Karry, Mem. Dent. Agr. India, En. Ser. 9 (1926) 217, Ramardishna Annae Mem. Dept. Agr. India, Ent. Sec. 10 (1928) 292, Priesner, Records Ind. Mas. 35 (1933) 465.

Food plants.—Setaria stalica, Cyperus sp., Miscantinus sp., and another plant of the Gram.new.

Habitats.—Taihoku, Shinten, Ikenohata near Bonbonsan, Hakumo near Tosei, Kahodai near Hassensan.

#### BAPAOTURES CHANESSE Prieser

Rapisthrips chineses Priesnin, Record Ind Mus. 35 (1933) 359. Hapisthrips mobilismmus f. fioricals Novinon (nec Priesner), Ann. Zool. Jap. 11 (1928) 320.

Food plants.—Ageratum sp., Astragalus sinicus, Adum fistulosum, Bidens pilosa, Bladhia meholdu, Castanea sp., Cirsium sp., Cicrodendrou sp., Curus spp., Camellia spp. Canna sp., Crotabria saltima, Chrysanthemum sp., Cryptotaonia canadensis, Gossymum indicam, Ipomoca batatus, Jasminum sp., Lactura debilis, Luffa cyundrica, Eria mudicantis, Murraya sp., Morus alba, Nephelium litchi, Narcissus tazetta, Ocnantho sp., Omits violucca, Primus sp., Polygonum sp., Prieraria thunbergiana, Rumex sp., Rosa sp., Rubus sp., Rephanus sp., Trifolium repens, etc.

Holitats.—Ta.hoku, Hichisetsan, Tathetsan, Urat, Shikikun, Saigen near Rato, Tonroka near Urat, Kyuko near Shinchiku, Hakku near Mosha, Inrin, Kagi, Arisan, Tainan, Ta.to, Taroko; Botel Tobago (Kotosho): the Pestadorea Islands.

Very common in the flowers; the Formosan specimens have been examined by Dr. H. Priesner. Haplothraps subtrissimus. Haliday does not exist in Formosa.

#### WAPLOTEBIES CHINGNESS Printers var. MONTHYAGUS Printers

Haplothrips chinensis Priesner var. montivegus Paresner, Philip. Journ. Sci. 57 (1935) 368.

Food plants.-Polygonum spp., Callicarpa formesana.

Habitate.—Taiboko, Urai, Taibeisan, Taroko, Kubodai neur Hassensan, Arlsan, Marikowan near Musha, Aderu and Budai near Heito, Torin (Taito-cho).

Very common in the flowers of Polygonam, especially in the mountainous regions

### HAPLOTERIPS CERTUS PRIMER.

Haplothrips certies PRIESNER, Troubia 9 (1939) 194; Record In l. Mus. 35 (1983) 353.

Haplothreps farmence Takamasin, feomogr. Insect. Japon. (1932) 1830.

Food plants.—Cyperus sp. and a plant of the Legummosm.

Habitets.-Talhoku, Shinten, Takao; Botel Tobago (Kotosho).

Rather common in the flowers of Cyperus The Formosan specimens have been compared with the types by Dr. H. Priesner.

#### BAPLOTHRUS VERNONIÆ Cvienez

Haplothrips contained var. Dermants Priessen Treman 2 (1921) 4, 7, Bull Deli Proofst, 23 (1925) fig. 17, RAMARRISHMA ÄNYAR, Mem Dept. Agr. India, Ent. Sec. 10 (1928) 292.

Has lethrops cornound PMESNER, Record Ind. Mus. 35 (1932) 360.

Food plants.—Chemas sativus, Callicarpa formosana, Celosia cristata, Gassypium indicum Ipomoeu bata'as, Lagerstroem andica, Melastoma candidam, Pleuropterus hypolencus, Puerura thunbergiana, and other species.

Habitats,-Taihosa, Shinten, Taroko Kahodai near Hassensan Herio.

#### HAPLOTHRIPS YERNONI'E Printer and GRANDIOR Printer

Haplothrips vernouse Priesner var. grandier PRESNER, Record. Ind Mus. 35 (1983) 361

Food plants.—Circhen sp., Lactura scariola, Momordica charantia

Habitat.-Taihoku.

### HAPLOTERIES ALLE Pricance.

Haplolorips ado Priesker, Philip. Jourt Sei. 67 (1935) 36L

Food plant.—Allium fietidesim.

Habitet,-Sankaiseki near Takao.

Very rare.

### HAPLOTERIPS LEI CANTERSH Schronk.

Haplothrups leacenthrum Schrank, PRIESNER, Thysan, Europ. (1923)

Food plant, -Frens retusa.

Habitat.-Make, the Pescadores Islands (June 1, 1930)

New to the fauna of Formosa. Many specimens were taken on a composite at Kaibato, Saghalien, by Dr. T. Shiraki, July 1930

At Make this species was found with Gyna kethrips uzel. Zimmerwan in the rolled leaves.

### HAPLOTHRIPS INQUITANUS Priemer.

Hopto, heips inquilibus Presner Treubia 2 (1921) d. 6, Karny, Mein. Dept. Agr. India. Est Ser 0 (1926) 216; Ramarishina Ayran, Mem Dept. Agr. India Est Ser 10 (1928) 292; Prisner, Record Ind. Mus. 35 (1935) 369, Takahashi, Bot. & Zool. Tokyo 2 (1934) 1830; Ramarishina Ayran, Record Ind. Mus. 36 (1934) 496.

Hab.tats.—Taiboku, Daitonsan, Sozan, Matsumine near Saramao, Hori, Taito.

This species is predatory, being found in the galls of other thrips on Piper futokadsura, Bladkia sicholdu, Mallotus repandus, Vit a shifuneusia, and Fiers retusa, but not in those on Smilax. Very common, especially on Piper.

#### HAPLOTHROPS PUSCIPENNIS Mention

Hoplethrens functiones MOULTON, Ann. Zool. Jap 41 (1928) 320.

Habitat.—Tarhoku.

Found in the gails of Smerinthothrips kineanai (Moulton) on Poper futokadmira

#### ALECRODOTHRIPS PASCIAPENNIS (Prockets).

Craptothrips fosciages his Franklin, Proc. U. S. Nat. Mas. 33 (1908) 727.

Alternate through fascianeruls Meturen, Ann. Zeol Jap. 11 (1928) 322; Taylan, Bull Ent. Res. 26 (1935) 53.

Habitats.—Taihoku, Kosoiko near Tainan.

This species is predatory and is found on Citrus, Osmanthus, and Buschofia. Very scarce.

### LECTWENTA PURNATRIX Priesner

Leenmenta pagnatur Priminen, Philip. Journ. Sci. 57 (1935) 373. Leenmenta ladious Taranasut (ace Bagnall), Iconogr. Insett Japon. (1932) 1888.

Food plant.-Lithocarpus sp.

Habitats Hori, Suisha.

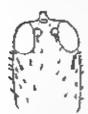
Found on the lower sides of the leaves.

### LEEUWENIA TARVANENSIS ap. nov

Forale.—Black; first antennal segment somewhat brownish black, second yellow, blackish especially on basal half, third pale yellow, slightly deeper in color on distal widehed part, fourth and fifth similar in color to third, but deeper in color on distal part, sixth pale yellow, darker and shaded with pale gray on

distal part, seventh yellow, dusky on distal half, eighth somewhat vellowish dasky; femora stack, fore tibus blackish yellow except on distal yellow part, middle and hind tibbe black except on distal one-third or one-fourth, which is yellow; tarsi yellow, dosky on distal half; bladders blackish yellow, wings pale brown; setar on head dusky, but those on posicior angles of abdominal segments pale yellowish.

Head including frontal produced part about 1.4 times as long as wide, straight and parallel on sides, very slightly narrowed at base, not constricted behind and across eyes, distinctly but only a little notched behind eyes; cheeks lacking granules and warts, nearly twice as long as eyes, with about seven to ten short spinelike sette which are about 0 023 mm long, irregularly arranged except on about basal third; vertical reticulations reaching a little behind posterior ocelli, but not postocekar



filtrationing of,

setse: postocular bristles short, about 0.042 mm long, pointed, distinctly apart from cheeks, a little nearer to cheeks than to the over, not reaching eyes: postocellar sette short, about 0.025 mm long, thin, slightly curved, reaching posterior ocelli, a little nearor to eyes than to oce.li, some small dorsal setse present except on posterior part. a second Eyes not protruding, parrower than vertex, nearly parallel on mesal margins, but slightly diverging anteriorly. Occili nearly equidistant, anterior

occilias directed forward, nearly reaching bases of antenna; posterior ocells in contact with eyes, a little smaller in diameter than distance between themselves, just anterior to a line drawn across the middle of eyes. Mouth parts reaching slightly beyond middle of prothorax, pointed. Antennæ rather slender, first seg ment wider than long, second much longer than wide, cylindrical, third widely but shallowly indented at middle of mesal side, third to sixth clavate, gradually widened distally, seventh gradually narrowed on bosal part, slightly so at apex, eighth not narrowed basally, lengths (and widths) of segments about as follows, III. 0.134 mm (0.942 mm), IV, 0.125 (0.046); V, 0.125 (0.042); VI, 0.115 (0.042); VII, 0.078 (0.032); VIII, 0.051 (0.018). Pronotum much shorter than head, not well reticulated, about 1.8 times as wide as long, with many small setse, and very stout antero- and postengular bristles and a lateral similar bristle at about middle, the bristles subequal in length, pointed, very slightly narrowed basaby, rather short, about 0 048 mm long, usually

very slightly curved on distal part, two short thin scies near anterior margin, much longer than other dorsal setse, much smaller than angular bristles, and much nearer to angular bristles than to each other. Pterothorax somewhat wider than abdomen, metanotum reticulated on median area of poster,or half. Fore come with a very stout sets similar to, but slightly shorter than, angular bristles of pronotum. Abdomen broadest at hase, gradually tapering; first tergite triangular, wider than long, second distinctly retlegiated on median area, second to eighth transversely reticulated ain with many sette in a group on lateral area, and some small selse on the median area, postang alar sette of segments stout, pointed, very slightly narrowed basaily, stouter than curved dorsal sets; erect, much shorter than segments, outer ones on seventh segment about 0.096 mm long, dorsal sette on lateral area of second about 0.03 mm long; tube long, but much shorter than remaining part of abdomen, as long as second to fourth argments taken together, broadest at base, a little tapering, eight times as long as wide at base, not swollen, slightly constricted at apex, sparsely beset with many thin sette, which are directed posteriorly, slightly curved, as long as width of spex of tube, none on busal and distal small parts, about ten of them discernib a along side. Wings nearly reaching seventh abdominal segment, broad, lacking fringe on small basel part of anterior margin, and on shorter distance of hind margin, with no double-fringed hairs. Fore femora stout twice as long as wide, not reticulated, as long as tibize, with many short sette, and two or three very long setas near base; middle and hind femora with a very long seta near base; fore tibus about 3.8 times as long as wide, with a much longer seta on the distal part, tarst large, lacking teeth; claws distinct. Body about 4.5 mm, head about 0.369 mm long, 0.268 mm wide, antenna about 0.748 mm long, pronotum about 0.254 mm long, 0.438 nun wide, pterothorax about 0.646 mm wide, first abdominal tergite about 0.231 mm wide, tube about 0.9 mm long, 0 115 mm wide at base, 0 0o7 mm wide at apex, fore femur about 0.277 mm long, fore tibia about 0.25 mm long,

Food plant.-Unknown.

Habitat .- Raisha.

Three specimens were taken by Dr. Y. Miwa, June 26, 1935, on a decayed tree. This species differs from all known members of the genus in the shorter tube. The most closely related form is Lecuvenia pagnetrix Priesper, which is easily distin-

guished from the present non species by the shape of the head and the longer tube. This species is strongly selecatived, not becoming pale even when treated with crust c potash, but becomes clear when soaked in Schulz's mixture. The type specimens are in the collection of the Department of Agriculture, Research Institute, Pormosa.

### ECACANTROTHRITS MATEUMPRAT Tabila.

Ecacumboth ips maiss sura [suna, Insecta Nats , Suppore \$ (1.22) 149.

Habitet .-- Tathoka.

The food habit is unknown.

#### ECACANTHOTERIPS SANGDINEUS Ragnall.

Rescantistures sangamens RAGNACL Tenos. Nat. Hist. Sec. Northumberland o. ser. 3 (1908) 535 (not available); Bagnall. Ann-Soc. Ent. Helg. 52 (1908) 348; Karny, Suppl. Ent. 2 (1913) 170, Moulton Am. Zool. Jap. 1 (1928) 722, Radake Shna Affak. Mem. Dept. Apr. India, Ent. Ser. 10 (1928) 574, Prinsher Treating 11 (1930) 361; Ishtipa, Insecta Mats., Sapporo 8 (1963) 148, Hoop. Stylops 4 (1935), 105.

Habitats.—Kosnun, Kosen (formerly Kosempo) The food habit is unknown.

# ECACANTHOTERIPS CONALIS Begand var. FORMOSENSIS var. nov.

Mule Black; antennæ dark, with a yellowish brown tinge, there and fourth segments paler on middle area of outer side. fifth and sixth segments slightly paier on basal half; sense cones dark on third, but transparent on other segments; wings hynine, slightly pale brownish on distal part, with a median gray line not reaching apex, which is obsolete about middle; femora black; fore tibiæ yellow, blackish along both sides, middle and hind tibue black, yellow on small dictal part, tarsi pale yellowish, dusky on the apox; sette dusky but those on hind angles of abdominal segments pale yellowish; capitate setse pale apicalby. Head including the frontal produced part 1.7 times as long as wide, about twice as long as prothorax, twice as long as tube, very slightly convex on cheeks, very slightly narrowed near base broadest across about middle of cheeks; cheeks over twice as long as eyes, without warts, but with three stout pointed setæ which are shorter a itemorty and about 0.014 to 0.023 mm long frontal produced part indented at apex, lateral postocular sets: stout capitate, approximately on cheeks, a little longer than setae on the cheeks, not reaching eyes, about 0.032 mm long: mesal postocular setæ very long, stiff, enumently camtate, directed anterplaterally, reacting beyond a line drawn across middle of ayes, laterad of eyes, slightly longer than eyes, as far apart from eyes as from checks, about 0.115 mm long. Fires not protrucing. Antennæ about 1.8 times as long as head; first segment wider than long, second longer than first, constricted baselly, third much car, owed on basel part, asymmetrical, more rounded on outer side, strinte on basal third, with fourteen sense cones in a single ring on distal part, and some long curved bristles, fourth stricte on basal half, with four sense cones; fifth very slightly stricte on basal part, slightly constricted on distaipart, with two sense cones; sixth similar to, but smaller than fifth, not stricte, seventh with a sense cone; eighth pointed apically, with a very long apical seta; bristles on third and fourth stooter than those on other segments; lengths (and widths) of segments about as follows: III, 0 115 mm (0.06 mm, 0.016 mm at basal part); IV, 0.115 (0.051; 0.018 at base); V, 6.115 (0.037); Vi, 0.083 (0.028); Vii, 0.065 (0.023); VII), 0.046 (0.014). Pronotom much wider than long, narrowed anterior y on anterior half, somewhat constricted behind middle, with a median black line not reaching margins; anterior angular acts stout. capitute, 0.058 mm long, lateral postangular sette similar to. but slightly longer than, anterior ones, 0.065 mm long; mesti postungular setar much longer; mid.ateral setæ much shorter than anterior angular ones. Fore come scarcely protruding beyond pterothorax, with two very stout pointed sets: equal in length, and a much shorter similar one, longer ones shorter than angular sets: on propotum, about 0.037 to 0.04 mm long. Pierothorax a little wider than long, on anterior part nearly as wide as posterior margin of prothorax including coxic, a little narrowed posteriorly. Abdomen broadest at base; first tengite triangular, as long as wide, rounded at corners; postangular bristles of abdominal segments stiff, capitate, as long as, or shorter than, seements, but those on both segment as long as tube, bristles on seventh segment about 0.129 mm long; tube stout, tapering, not awollen, twice as long as wide at base, base twice as wide as apex apical long sets: longer than tube. Wing a narrow. Fore femora stout, about twice as long as wide, broadly rounded on fateral aide, with a long fine sets on busal part, and a distinct tooth at about mid lie and also at end, teeth pointed, longer than wide, distal one conical, expanded towards base, slightly shorter, but more sharply pointed than basal one; middle femore thrice as long as wide, with two long, stout, cap-

state acte on anterior margin, which are about 0.037 to 0.042 rum long; hind femous about four times as long as wide, with three long, stout, capitate sets and a few shorter pointed ones in a row on anterior margin: these capitate sets slightly curved: fore tibize shorter than femora, 4.5 times as long as wide, with a very small rounded tubercle on basal part and one or two similar ones on distal part, which are wider than long, one or two very short moistmet teeth also discernible on middle part and a long fine seta on distal part; fore tarsi with an emment tooth, which is pointed, distinctly longer than wide, alightly indented on mesal side, expanded hasalty very slightly rounded on lateral side, and slightly shorter than width of tarsi-Body about 2.15 nrm, antenna about 0.65 nrm, scare cone on third antennal acgment about 0 037 mm long, head including frontal produced part about 0 369 inm long, 0.203 mm wide across eyes, 0.102 mm wide in front of eyes, 0.217 mm wide across cheeks, eyes 0 102 mm long, pronotum 0,346 mm wide at hind end, mesotherax about 0.425 mm wide, tube 0.185 nm long, 0.002 mm wide at the base, longer apical setse 0.22 mm long, hind wing 0.046 mm wide, fore femur 0.323 mm long, basal tubercle 0.03 mm long, tarkal tooth 0.032 mm long.

Rabitat.—Herto.

A single specimen was taken on a decayed branch of Artocurpus, March, 1935, by Mr. R. Yamaho. The food habit is not known. Differs from the typical form of Ecocanthothrips corals Bagnall in the following characters. The third and fourth antennal segments paler on the middle of the lateral part, the fourth and fifth not distinctly paler at the base. Fore femora narrower, twice as long as wide. Sette on the pronotion longer. Tooth on the fore tarst very slightly indented on the mesal margin, expanded basally. Middle and find femora with eminent capitate sette. The type specimen is in the collection of the Department of Agriculture Research Institute, Formosa.

### GIGANTOTHRIPS CRAWFORD Road.

Giganisthrips cranefords Roop, Insec Insect. Monet. 7 (1919) 71.
Giganisthrips elegens Taxanasin (sec Zimmerman), Bot. & Zool.
Tokyo Z (1934) 1829.

Food plants.—Ficus nerrosa, F. nightiana, F. sp. Habitats.—Tathoku, Shinten, Hakumo near Tosei, Hori, Shirin near Taihoku.

Sometimes occurs in large numbers on the lower sides of the leaves. Does not form galls. Previously known from the Philippines.

### GIGANTOTERES VENAPENNIS Mostles.

Gigarlothripe venopennis Mounton, Trans. Nat. Hist. Soc. Formosa 18 (1928) 321.

Food plant,—Unknown, Habitet.—Kagi.

#### MEGATHRIPINÆ

#### EGAPHROTORIPS VALCATOS KARRY.

Emphrothrus fabritis Karny Ent. Ronds. 29 (19 2) 150; Moulton, Ann. Zool. Jap. 11 (1928) 322; Takahashi, Iconogr. Insect. Japon (1932) 1888; Friesner, Rev. Zool. Bot. Africa. 22 (1932) 330. Decagathripe falcatus Priesner, Roll. Lab. Zool. Portic. 21 1927) 80

Haditats.—Kagi, Shinten.

Found on the stems and branches of Artocarpus integrifolia, Steresdia nobile, and Psidium quajava.

### PLAPHROTHRIPS FORMOSANUS (Karay)

Idetothrips formessens Kanny, Suppl. Ent. 2 (1913) 130, Mourton, Ann. Zool. Jap. 11 (1928) 336.

Elaphrothrips formusanus Palesnas, Konow 2 13 (1934) 193, 14 (1955) 64.

Food plant.—Unknown. Habitat.—Takao.

#### MACHATOTHRIPS ARTOUARFI Monitor.

Machatothrips artocarps Moulton, Trans. Nat. Hist. Soc. Formess 18 (1928) 322; Takahaski, Iconogy Insect. Jupon. (1932) 1889, Friesnes, Rev. Zool. Bot. Africa 22 (1932) 344

Habitats.—Kagi, Heito, Kuraru.

Found on the stem of Artocarpus integrifulia and under the bark of decayed trees.

### MACEATOTURIPS CELOSIS: Meetion.

Alachatothripa erlosite Moulron, Trans. Nat. Hist. Soc. Fermiosa 18 (1928) 325 Palesner, Rev. Zool. Bot. Africa 22 (1932) 344.

Food plant - Celesia as gentea.

Habitet -- Kagi.

### PHOXOTHRUS PUGITOR KINDY.

Phoxothrips pugitor Karny, Suppl. Ent. 2 (1913) 102; Mouleon, Ann. Zool - ap. 11 (1928) 337.

Food plant,—Unknown.

Habilut.—Koshun.

# REARDOTHERS LATEVENTEDS Karny.

Whiebally ps intirentric Karry, Suppl. Ent. 2 (1913, 129; Acta Soc. Ent. Czoch, 17 (1920) 42; Archay f. Zool, 17 (1924) 12, Modelton, Ann. Zool, Jap. 11 (1928) 337, Prizania, Philip. Journ. Sci. 57 (1935) 370

Food plant-Gossypium indicum

Habitats. Tathoku, Kagi, Anpin.

Found in the cotton bolis in Formosa, though taken on Gassia occidentalis at Koronya, Ponape Island (Japanese South Scalslands).

Machatothrips upomock Ishida ' may be identical with this species.

'Insecta Mats. 7 (1952) 12

# ILLUSTRATIONS

# TEXT FIGURES

- Fig. 1. Twisthrips arolly sp. nov ; head of adult female.
  - 2. Smerinthothrope litiacom Moulton, gul
  - 3. Smerenthothrips humanai (Moulton); galls on Piper fatukadsure,
  - 4. Lecumenia taiwenensis sp. not., head.

# THE NASUTE TERMITES OF THE PHILIPPINES

By S. F. LIGHT and F. J. WILSON Of the University of Cut forms, Berkeley

#### TWENTY-BIX TEXT FIGURES

#### PHILIPPINE NASUTE TERMITES

Genus Laccasififermes Holmgren.

- 1. Leostattiforetes palarcarensis Light,
- 2. Lareseit termes holmgreni sp. nov

Genus Hospitalitermes Holmgren.

3. Hospitaliterince Inconensis (Oshima)

Genus Gradalatermer Holmgren.

- 4. Grakaisternies admiravilus Light.
- 3. Grallatetermen upleudidus sp. nov.

Genus Nosutitorines Banks

Subgenus Havifundifermer Light.

6. Naentitermes atripennie Havdand).

Subgenus Numeritermen sen, str.

- I. Nasatitermes gracilis (Oshima)
- 5. Nasatitermes molles sp. nov.
- 9. Nasatifermes liezomens (Oshima).
- 10. Nasotitermes emulans sp. nov.
- 11. Namel termes lates sp. nov.
- 12 Nasutitermes panagemais (Oshima)
- 13. Naantstermen meridiamus sp. nov.
- 14. Nasutifermes pahimal sp. 1164.
- 15. Nosuitierines chapment sp. nev.
- 16. Nasatiformes parture sp. nov.
- 17. Nasutitarines rotundus sp. hov.
- 18. Nasatiformes balbitauacensis (Oshima).
- 19. Nesztitermes tanleri ap. nov.
- 20. Nasiditermes castanens (Oshima)
- 21 Nasutitormes megragori (Oshima)
- 22. Nasutiterines constructioens sp. nov.
- 23. Nasicuterines businenge sp. nov.
- 24 Nasutitormes browlearnes sp. nov

Genus Subuliterines Holmeren

- 25. Subulitermes purreeles sp. nev.
- 26. Subalitermee mindaneusie sp pov

#### INTRODUCTION

Forty eight species of termites have been reported from the Philippines, two by Hagen (1858), one by Haviland (1898),

thirty by Oshima (13t), 1916, 1917, 1920), and officen by Light (1921, 1929, 1930). Previous reductions to synonymy (Light, 1930) decreased that total to thirty-nine (Light, 1930, with the addition of Neoternics grands Light which was omitted from the list). Of these thirty-nine species system are musule, thirteen of them recorded by Oshima (1914, 1916, 1917, 1920) and three by Light (1930). Oshima's Enternics minutes (1917, was reduced by Light (1930) on the basis of Oshima's statement that this was a manuscript name replaced by N. gracius, which appeared by mistake.

Of these thirteen has its species of Oshima six are reduced to synonymy in this paper, as follows:

Entermes (Hospitalitermes) hospitalis (Havrand) Oshima, 1920, to Hospitalitermes tuzouenes (Oshima).

Entermes (Hospitalitermes) services is Osh ma, 1916 to Hospitalitermes incomensis (Oshima).

Enterince (Entermes) Inseptions was Oshuma, 1920 to Nasutiteria's (Yatutiteria's) luxonicus (Oshuma)

Enternos (Entermen) manitones Oshima, 1916, to Austritormes (Vanutitermes) hizamone (Osh ma)

Entermes (Triverestermes) menada pel Oshima, 1920 to Nasattermes (Nasattermes, tezon pas (Osh ma)

Enterwes (Rollandstermes) entoseems Oshima, 1920, to Masalstermes (Nasalstermes) gracific (Oshima)

Sixteen new species are described, however, which makes a total of forty-nine species of termites known to occur in the Philippine Archipelago to date, of which twenty six are nasutes, as listed at the head of this paper.

The material studied by Oshlina included a small collection from Dr. C. F. Baker made in the vicinity of the College of Agriculture at Los Banos, Laguna Province, Luzou, and several collections made by R. C. McGregor in various parts of the Archipelago. The named collections of Doctor Oshima, formerly in the Government Institute of Science, Talhoku, Formosa, were briefly studied there by the senior author in 1922. They were removed when Doctor Oshima returned to Japan (fide 1. Shiraki). It is extremely unfortunate that Oshima's types were not available for study at this time, since, indging from conditions of preservation in 1922, they are destined to rapid deterioration. Furthermore, Oshima designated neither a holotype nor a type collection, and our observations indicated that the various collections labeled as belonging to a single species often actually represented two or more species. Autotype specimens of a few

species have been available during this investigation. These were kindly sent by Doctor Oshima at Mr. McGregor's request when the senior author first began the study of Philippine termites. Many of Oshima's vasure species were not represented in this material nor is the exact type status of this material known in all cases. Incomplete as it is, it has nevertheless been of the greatest value in settling certain difficult questions.

In spite of this paucity of authentic comparative mater'al, all but one of Oslima's thirteen species of misutes have been accounted for. Six have been found to be synonymous with other species described by Oshima and present in our collections. The remaining six occur in our collections and have been identified and redescribed. The single species yet to be redescribed is Assistances incorregori Oshima. Oshima's descriptions in general are not sufficiently definite or complete as regards diagnostic specific characters to a low for ready identification of his species, but this one unrevised species seems more than usually definite and has been incorporated on the basis of characters given in Oshima's descriptions and figures.

### MATERIAL STUDIED

Extensive collections representing approximately 370 colonies were used in this study. Numerous persons have contributed to these collections, among whom must be mentioned Mr. R. C. McGregor, of the Philippine Bureau of Science, and Dr. E. H. Taylor, formerly of the Bureau of Science, now in the University of Kansas.

Numerous species are represented in the collection by but one or two colonies, a condition which indicates the necessity for careful collecting in the less-frequented regions. Such collecting may be expected to yield unknown species and to increase the known range of those here reported. These new species are to be expected chiefly in the mountainous areas, particularly in the southern islands of the Philippines. The species characteristic of the lowland famous in various parts of the Islands are undoubtedly reported here. The two dominant species, as will be seen by referring to the lists of collections, are Nasriticines incomens (Oshima) and N parametric (Oshima). Nasniterness incomens (Oshima) and N parametric (Oshima). Nasniterness incomens, the common black-headed Philippine nasute, while occurring throughout the Archipelago, is common only in the northern portion of its range, especially in Luzon, where it is the common masute and one of the commonest termites. Nasniter-

mes parageness, the common brown-headed Philippine nasate, is the dominant nasate species throughout the Visayas and one of the commonest elements of the termite fauna there.

### METHODS

Descriptions have been restricted to brief diagnoses involving characters expected to be of value in specific differentiation. No attempt has been made to describe workers, since these are not satisfactory for specific differentiation in the present state of our knowledge. Hlustrations have been confined to line drawings, chiefly of the head, which bring out such diagnostic characters as dorsal profile, shape, length, and position of the rostrum in the case of the soldiers; and size of eyes and occili and the distances separating them in the alates. In addition the left mandible of the soldiers is illustrated for the species of Nasutitermes sen, str. as adding useful characters to the relatively meager set available for differentiating species in this difficult group.

### TYPES

It is the practice among systematic students of the termites to choose a type colony, one individual of which is separated as the holotype, other members of which are known as paratypes, as are the members of other colonies of the same species investigated. We have followed this procedure, designating the type colony by its number in the collection of the senior author. Holotypes have been deposited in the United States National Museum save in the case of monotypic species, the types of which are retained in the collection of the senior author. Paratypes are retained in the senior author's collection; and, where available, paratypes have been deposited in the collection of Prof. A. E. Emerson, of the University of Chicago. Type collections, as complete as possible, are also to be deposited in the Philippine Bureau of Science, Manila, and in the museum of the California Academy of Sciences, in San Francisco.

# TERMS AND MEASUREMENTS

The measurements and indices used in this paper are in general the same as those used in other papers of the senior author. Some, however, are new, devised to facilitate description of the characters of the nasute soldier. The dimensions and indices used are defined in the succeeding paragraphs.

Head measurements for the slate are all made with the head flat and with the dorsal side up. "Length of head of alate" (fig. 1, on) is incasured from tip of labrum to posterior margin

of head. "Length of head capsule of alate" (fig. 1, mn) is here measured from the middle of the anterior end of the capsule to the center of the posterior margin of the head. "Width of head capsule of alate" (fig. 1 m) is measured just beaind the eyes. "Width of head with eyes" (fig. 1, pq) is width through centers of eyes. "Lougth of proportion" is measured at the middle (from

notch to notch if present) and "with of prenotum" is maximum width. Eye and occlus measurements are made with the head turned so as to avoid foreshortening.

All measurements for the head of the nasute, except head width, are measured with the head in side view, and with the sagittal plane horizontal, "Length of head with rostrum? (fig. 1, bc) is measured in side view with the ventral surface of the head. parallel to the scale "Langth of rostrum" (fig 1, de)

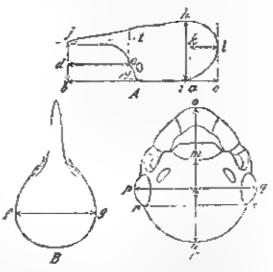


Fig. 1. Mestal-terment taylors up, now, dusting drawmate of need of older and of addies, to idustrate the discression used, A, head of relater in material rices, B, brad of soldier in derast view is junction of head and week, he length of heat while restricting, descriptly at vectors, fg, width of head in height of head of soldier of head aposton was, brugith of head objects of white pay, brugith of sold of sol

is measured parallel to the base line with the head, in the same position as for length of head with rostrum, from the innermost point of the front of the head below the Lase of the rostrum to a line from the tip of the rostrum perpendicular to the base line. This value is less than the actual length of the rostrum, therefore, when the rostrum is either elevated or depressed (fig. I, ji). "Head length without rostrum" is of course, the difference between the last two measurements. "Head production" is the horizontal extension (fig. 1, ac) of the head belond the posterior articulation of neck with head (fig. 1, a). "Head width" is measured at the widest point across the dorsal surface. "Head index" is obtained by dividing head width by head length

4.

without rostrum; "head-rostrum index." by dividing rostrum length by head length without rostrum, "head production index." by dividing head production by head length; and "leg clongation index," by dividing length of fore tibia by length of head without rostrum.

All extensively used indices have been prrived at, it will be seen, by dividing the particular dimension by head length without rostrum. Others are defined where first used.

The subgroups of nasuta termites of the genus Entermes Hagen (now Nasattlermes Banks) Jefined by Holmgren (1911, 1913) as subgenera are variously used by different authors, us subgenera and genera. Awarting a much-needed revision to determine their proper status, it seems wise to folk withe custom. Thus, we have here used them as genera in this pape, following the lead set in the earlier papers of the semon author on Philippine termites (1930) and that of Kemner (1934), although in the senior author's studies of American termites he has followed the lead of Emerson and Snyder and considered them as subgenera (1930)

Soldiers of the smaller species show certain characters that suggest the possibility that they may belong to one or the other of the subgenera briefly differentiated by Rolmgren (1911). The fact that the postelyneus is short in the workers of all gave N mindamensis so, nov. and N. marriedes an nov. and in the alates where present makes it impossible to place these save in Nasyliternics sen, str. This holds for the species variously placed by Oshima in Grallatotermes, Returditermes, Coulomtermes, and Trinervitermes.

Nusnittermes mindanensis, certainty, and N. marireles, somewhat doubtfully, belong to Substiternes, as indicated by the longer swollen postelypeus of the worker and the lack (S. mmdenonsis) or vestigial nature (S. mari eles) of the free apleal portion of the soldier manditle. We have followed Kemner in considering Subuliterness a separate genus, although the differences seem more nearly of subgeneric value.

Key to the genera of namete termites found in the Philippene Islands.

- I. Smaller, head with eyes less than 1 60 mm wide pronotom light save in amaller species
  - Subulitarmes Ho mgron, Nasulitarmes, subpenus Nasulitarmes s s. Larger head with wes more than 1 70 mm wide; pronotons dark
- 2, 2 Antennal segment III slightly, if at all, longer than II 3. Antennal segment III markedly longer than II

- Wings yellow-brown, eyes very large and prominent; promotem with central notch in poster or margin. Graliatotermen Holmeren.
   Wings black-brown; eyes medium in size; pronotum without notch in posterior margin... Nassistormes, subgenus Hawfenditermes Light.
- 4 Antennal segment III twice as long as II; wing membrane unpugmented

  Hospitaliterman Hologren.
  - Antenna segment III about one and one-half times as long as IV wing numbrane pigmented, brown ..... Laccasitionnes Holmgren.

#### SOLDRERS

Nasutitorines, subgemis Manuanditermes Light

2. Free apical portion of mandible lacking or vestigial; postelypeus of worker swollen, about half as ong as wide. Subultermes Homgron. Free apical portion of mandible well developed; postelypeus of worker not especially swollen, less than half as long as wide.

Nasatitermes subgenus Nasatitermes sen. etc.

- 4 Restrum short and thick, legs only moderately elongated, hind femora considerably short of end of abdomen. Grahateternica Holmgen Rostrum long or shorter and very slender, legs greatly elongated, hind femora longer than abdomen.

Hospitaltiermes Halmgren

#### Genus LACESSIT/TERMES Helmaron

Key to the tree Philippine species of Lucesulttermes

#### ALATES

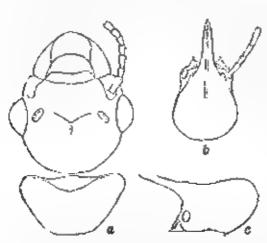
#### SOLDIERS

- I GACESCHITERMES PALAWANENSIS LIEBI VERLÜE 2 Laccionalicament paragramentsis Liebi Verlüge 2

Dealate (young queen).—Generally dark brown; head blackbrown, postelypeus light brown, autennæ yellow, pronotum rusty

yellow-brown. Ocelli (fig. 2, a) separated from eyes by more than their long diameter but less than twice their short diameter: width between eyes 122 mm; head width through eyes 180 mm. Fontanel (fig. 2, α) narrow, slithke; region about fontanel only slightly sunken. Posterior margin of pronotum entire (fig. 2, a); mesonotum and metanotum roundly excavated, corners rounded.

Soldier (fig. 2, b and c) - Head black-brown; nota, tergites, and first segment of antennæ dark smoky brown; coxæ, femora,



the, z Laconitatermes pulsaranearis Light a head rior; head length 1.75 and presettent of winte an derect view b and c. head of militier in derival and lateral views, respectively, to 1.85 mm, head width

and region of head about autenna rusty b. own, tibiæ, tarsi, and distal halves of antennæ very light yellowbrown: rostrum of same color as head or with an indistinct paler apical region: rostrum relatively slender. Segment II of antennæ distinctly shorter than III (fig. 2, b); head without hairs or with one or two hairs near poste-

about 1 mm; hend rela-

tively short; head-rostrum index about 0.70. All abdominal tergites with a posterior row of stiff hairs.

Measurements in millimeters of a quoen of Luccasitaterines paramanensis

IMGAE.	
Length of head	2.16
Length of head capsule	IAO
Width of head through eyes	1.83
Long diameter of ocallus	0.20
Length of fontanel	0.11
Diameter of eye	
Distance between towns	0.45
Distance between inner margins of eyes	1.43
Length of antennal segment I	0.24
Length of antennal segment II	
The same of the sa	0.15
Length of antennal segment III	0.22
Length of pronotunt	
1972 Ach . A	0.81
Width of prenoture	0.50

Mennuroments in millimeters of a soldier of Lacesuititermes pulawanesses.

Linkt

Length of head	1.62
Length of rosteum	0.67
Width of head	1.02
Width of pronotum	0.58
Length of pronotum	0.26
Length of hand tibes	2.15
Head-rostrum index	0.50

Biology and distribution.—The single colony was taken in 1923 by Dr. E. H. Taylor on Thumb Peak near Iwabig, Palawan.

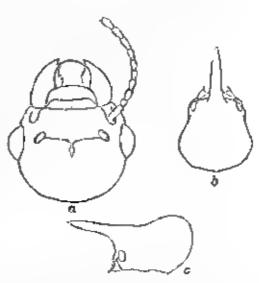
He reported the species as occurring to an elevation of above 4,500 feet and building small, very light, paper nexts in small shrubs or rattan. He also reports that there were no covered rimways above or below the nest, which would mean test the species is a forager, as its long legs and dark color would indicate.

c. LACESSITTERMES ROLL.

CREAT IS MY Test of x

Alate (fig 3, a).—

Generally dark brown;
bead black-brown; postclypeus yellow-brown;
antenna light yellow-



Ptc. 3. interspiritement having rest up. nov., a, bread of allow in dorsal views b and c, bread of soldier in dorsal and attend were, respectively.

brown; pronotum dark brown, lighter behind. Oceill separated from eyes by about their long diameter, width between the eyes 150 mm, width of head through the eyes 2.08 mm. Fontanel large, lancet-shaped, in a strongly sunken area. Posterior margin of pronotum deeply notched, mesonotum and metanotum roundly excavated, the corners angular.

Soldier (fig. 3, b and c).—Head black; note and tergites dark brown' antenne, lateral thoracic sugments, and come brown; femora yellow-brown; tibke and tarsi lighter; rostrum relatively short, with apical rendish area. Segments II and III of antenne subequal. Head without hairs or with one or two posterior hairs; head length about 1.80 mm, head width about 1 mm. All abdominal tergites with a single posterior row of stiff bars.

# DESCRIPTIONS

Alaic.—Head dark mahogany brown; postchypeus, antenne, and legs yellow-brown; labrum very light ye low-brown; pronotum brown, lighter posteriorly, mesonotum and metanotum anteriorly ivory brown, darker posteriorly; tergites dark brown; steraites brown, centrally slightly paler; wing membrane light brown, radius sector deep brown, costal margin brown, subcostal stripe nearly as wide as radius sector, brown with yellow cast.

Head shaped as in fig. 3, a; central region of head about fortanel markedly sunken.

Fontanel (fig. 2, a) lancet shaped, more than half as wide as occliss and slightly longer, flaring anteriorly to form lateral points, which continue to the occliss a funt lines.

Ocehus (fig. 3, a) elliptical, long diameter about one-third that of eye; separated from eye by the long diameter of ocellas.

Eye projecting, Large, separated from lower margin of head by about one-fifth its own diameter, from upper margin of head by about one-half its own diameter, and from posterior margin by somewhat more than its own diameter; width of head between eyes 1.85 mm.

Antennæ of about the same color throughout, segment II much shorter than III

Measurements in millimeters of a typical state of Laccinitierms halmgreat up, now, from the type sollection, No. 1712.

Length over all	16 01
Length of forewing	14.17
Width of forewing	3 86
Length of head	2 16
Lungth of head suppula	150
Width of head copsule	1.57
Width of head with eyes	187
Length of pronotum	0.544
Width of pronoton	1.54
Diameter of eye	0.55
Long diameter of occilus	0.20
Short diameter of ocellus	0 16
	V 10

Soldier.—Head and rostrum deep black-brown shading into mahogany brown at base; distal one-fourth to one-fifth of ros-

trum reddish; note and tergites dark brown; antennæ, lateral thoracic sciences and coxe brown; tibiæ and tarsi somewhat lighter.

Head and rostrum shaped as in fig. 3, b and o; rostrum elevated, with a slight hump near its base; rostrum basally thick, tapering throughout, about 0.2 mm thick at middle

Antennæ twice as long as head with rostrum, same color throughout: segments VII and VIII longest, distal segments decreasing in length; segment III shorter than or nearly as long as IV.

Menourements in millimeters, and indices, of a typical soldier of Luccess is termes helingreni sp. nov., from the type collection, No. 1712

sength of head and rostrum	1.80
Length of head without rostrum	1.06
Length of restrain	0.72
Head production	0.27
Reight of head	0.96
Width of head	114
Length of fore tible	1.32
Head index	0.90
Head-restrum index	0.68
Head production index	9.28
Leg elangation index	1.15

Biology and distribution. Three collections were made by A. C. Duyag, in May and June, 1984, all from Dinagat, Dinagat Island, Surigae Prevince, just north of the northernmost point of Mindanae. All contained queens and one contained alates. Nothing is known of their biology, but they are almost certainly carton-nest builders.

Systematic position.—The plate of this species differs from all save that of L. polaronensis in the combination of large head size with ocelli removed from the eves by about their long diameter. The first form reproductive differs from that of L. polaronnensis, which otherwise it resembles very closely, in the larger fontanel and the notched posterior margin of the propotum.

The soldier keys out to L. ransonett Holmgren in Holmgren's key (1913). From this species it differs, however, in being larger with much thicker and somewhat longer rostrum. From L. palawanensis Light the passite differs markedly in its much longer, thicker rostrum with a red tip.

## Genus HOSPITALITERMES Holmgren

S. HOUPSTALITERMES LUZONENSIS Colinia. Test Sp. 4

Futermes (Hospitalitermes) saratemas Oshima, 1916.
 Eutermes (Hospitalitermes) lazonensis Oshima, 1917.

? Euternes (Hospitaliternes) Fospitalis Oskima, 1916, 1920.

Alate—Head posteriorly brownish black, anteriorly brown; postelypeus same color as head; labrum light brown; unternæ light brownish yeliow; pronotum dark brown bordered laterally with very light yellowish brown; mesonotum and metanotum light brown; tergites dark brown; sternites brown, centrally pale; wing membrane pale whitish with faint yellowish tinge.

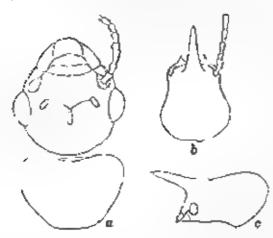


Fig. 4. Haspiteliterates (economic Colonia or head and Just Posterior to a line posterior of there is donat view is out a seed of joining posterior mark-soldier in donat and lateral views, respectively.

nlmost unpigmented save for dark brown radius sector and light brown costal margin.

Head shaped as in fig. 6, α; broad behind, frontal region constructed; eyes wide apart, protruding.

Fontanel (Lg. 4, a) s m o o thly alliptical, about equal to occllus in length but parrower than occllus, located just posterior to a line joining posterior margins of ceelli, in a ridge

which separates two lateral sunken areas; from sunken, especially so immediately in front of fontanel.

Ocelli elliptical, more than one-half as wide as long, nearly vertical in position; separated from eye by at least short diameter of ocellus.

Eye separated from lower margin of head by about one-lifth, from upper margin of head by nearly one-half, and from posterior margin by slightly more than, its own diameter.

Antennæ somewhat elongated, decreasing in writh distally, of lifteen or sixteen segments; where fifteen, III much the longest, at least twice as long as II; where sixteen, II and IV sobequal, III larger.

Pronotum (fig. 4, a) long, considerably longer than one-half its width, broadest near anterior end; anterior margin somewhat uplified at center, nearly straight but with median emargination; anterolateral corners rolanded, sides nearly straight, strongly receding, rounding very broadly into narrow, slightly convex, posterior margin; posterior region of pronotum depressed. Mosomotum and motanotum angularly excavate behind, metanotum deeply so.

Wings heavily baired but without other ornamentation; hairs evenly distributed on membrane; median and cubitus and its branches marked by close-set lines of hairs set off by clear zones on either side, median near cubitus; cubitus with six unbranched based branches, the first five relatively heavily pigmented, the sixth with some pigment distally distal branches of cubitus from three to six, unpigmented, one or more branched. No costa, stripe, usual dark zone behind radius sector narrower than vein.

Measurements in millimeters of an afate of Hospitalitermes In-manusis.

Oskimo, from codection 223, from Basilan Island.

	• • · · · · · · · · · · · · · · · · · ·
Length over all	14 35
Length of forewing	12.70
Width of forewing	2.50
Longth of head	1.74
Length of head capsule	1 25
Waith of head capsule	1 31
Width of head with eyes	1 63
Length of pronotion	0.90
Width of pronotom	1.45
Diameter of eye	0.45
Long diameter of poeling	9.10
Short diameter of occilus	0 12

Soldier (fig. 5, b and e) — Head black to dark mahogany brown behind, lighter anteriorly, distal half of rostrum lighter when head is darkly pigmented. Antennæ, nota, tergites, coxæ, and femora dark brown, heavily pigmented, nota darkest; sternites, tibiss, and tarsi pale.

Head and rostrum shaped as in fig. 4, b and c. Head enermously produced and remarkably elevated behind, rostrum short, slender, somewhat uplifted; dorsal profile deeply concave

Antenna of fourteen segments, greatly elongate, nearly as long as body Forelegs about as long as antenna, other legs much longer.

Measurements in millimeters, and indices, of a soldier of Hospitalitermes lucencusis Orbinsa from cudection ses, from Bas lan Island.

Length of head and restrum	1.74
Length of head without restruct	1.20
Length of rostrom	0.54
Head production	0.54
Height of head	0.87
Width of bend	1.11
Length of hind this	2.10
Head index	0.93
Head-rostrum index	0.45
Head production undex	0 45
Leg elongation index	1.60

Systematic position Examination of a long series from various parts of the Arempelago indicates the presence of a single, widespread, highly variable species of this genus.

This species agrees with the paratypes of *H. luzonensis* (Oshima), which were available for comparison. No satisfactory differences between this species and *H. saraiensis* and *H. hospitalis* are to be derived from the descriptions. The inference is that there is but the single species of the genus in the Philippines, but until type material of Oshima's *H. saraiensis* is available it seems best to retain the more recent name.

Oshima correctly considered the common Philippine species, his H luzonensis to be distinct. As brought out in part by the table below it is nearest to H. hospitalis (Haviland), but differs from it in that the soldier has paler antennæ, in that the antennæ of H luzoneusis are considerably less clongated than those of H. hospitalis, and in that the legs are considerably shorter actually and it proportion to the head length than in H. hospitalis.

These differences in the soldiers are brought out in the table below, which presents certain characters of the common Malayan and Indian species. The indices recorded were obtained as follows: "Heac-rostrum index" by dividing head length by rostrum length (p. 466), "HI-index" by dividing the length of antennal segment III by the length of head with rostrum, and "tibial index" by dividing the length of the head with rostrum by the length of hand both

The close agreement in length of head with rostrum in this group of five species is notable as is the great variation in rostrum length within H. histonesis as brought out by a range

in head-rostrum index of from 0.36 to 0.50 in the five specimens whose measurements are presented. This probably represents the extremes, however, for the range in another group of nineteen was only from 0.40 to 0.47. Evidently, however, this index will only be available when range and average are known. III-index seems more diagnostic, after although here there is a range from 0.12 to 0.16 in II historiesis, indicating considerable var attom in length of segment III (as also, of course in the head length), yet this figure is always less than that found for the single individual of II hospitals available. The tibial index also presents possibilities for diagnostic purposes.

Compar son of Oriental species of Hospitalitermen Holingren.

	•			_		
	Nyceica.	l Souper.	l engtion of head arist touch touch touch	deneth of head	factorial rid control m	E-ad-of accompretellar passesses segment
			Willey	mpron,	Post 1	লাভ,
	d Fou picked Makeur a Frag pitalisa	for the control of	. 174	3.28	a2	P. 49 0 338
	Prospitulitarines hisonenne	., Lugares (cotypes)	1 107	8.2	0.48	0.06 8 398
	Dw	156	1.76	E 22	0.1	9 41 79 261
	Da	. * Baget Norte	3.63	1.28	0.94	16 47 Fr 29
	Da	Mintoro	1.40	1.20	0.60	0 3 # Z. 8 1
	Lia	. d»	t	1.19	0.52	4 45 9 232
	Despitation one a missioner	Harnen.	1.75	1 195	0.62	0 63 4 3/45
	Петриней вистем портигана	Ceylon	1.68	1 22	0.46 }	9 34 3 244
		Aliz .	1.56	1 33	0 44	4 a3 m 626
•	Hagibilitere in flactioniste	Majores,	1 20	1 13	9 63	o ns 10 015
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	elkerjulasidermes karps affa.	Вологи	B William	и 19	264 0	6" j. Very datal.
		Lugues (outsides)	A R. 2475	0.16	<b>2</b> 46 0	"B" Dark
	Do	4k0	€ 256 T	0.15	2 2H , 1/4	₂ <b>€</b> 30.
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ì	HerpifelBerner fananstra	Malaeca.	in 23	0.14	43 B	YE TARBET
1,			,	,		

Distribution.—This species is widespread throughout the Archipelago. The collections in hand range from the northern

end of Luzon to Palawan and the southern end of Mindanao In Luzon the following provinces are represented: Hocos Norte, Cagayan, Pangasman, Pampanga, Bataan, Rizal, Laguna, Cavite, and Tayabas (including Marinduque Island). There are many collections from some of these provinces, and without doubt search would prove the species to be present in all the others. In addition there are collections from Mindanao, Samar, Panay, Cebu, Negros, Palawan, and Bashan Islands, and no doubt the species would be found in all other islands of any size. No other species, save, of course, Macroterman gibrus, the mound builler, and perhaps Neoterman unlatensis, has so wide a distribution in the Archipelage

Riology.—This species, like others of the genus studied in Ceylon and elsewhere, is a day forager. Its armies extend for a distance of at least several hundred yards, consisting of five or six lines of workers, flunked by an outer cordon of soldiers. They gather fragments of decayed leaves, possibly of fungus, which are taken to the nest—a large, dark brown to black structure at the base of a tree giving off an unpleasant odor. This species, whose nests are to be found by careful search almost on the outskirts of Manila, offers a remarkable opportanity for a study of social organization, caste determination, feeding methods, behavior, etc.

## Genus GRALLATOTERMES Holmgren

This genus, separated as a subgenus by Holmgren (1912) for Termes grallator Desneux, seems to consist of relict species.—G. grallator (Desneux) in New Guinea, G. grallatoriformis (Holmgren) in the Anamala! Hills of northern India (1917), G. weyeri Kemner (1913) in Amboina, G. admirability Light (1930) in Negros, Panay and Mindanao, and G. splendidus sp. nov. in the depths of a swamp about Lake Casili, near Arayat, Pampanga. All collections of the Philippine species were from virgin forest, which probably explains their restricted distribution.

Oshima's species assigned to the subgenus Grallatotermes, Entermes (G.) brevirostris from the Caroline Islands (1917) and Entermes (G.) luxonicus and E. (G.) panayensis from the Philippines, as also Snyder's N (G.) oceanicum from the Santa Cruz Archipelago, belong to the genus Nasuditermes, the Entermes sen, str. of Holmgren.

Key to the suddiers of the two Phillips no specus of Grallatotermes.

Hologram.

1 Head black or black-brown body, antenne, and logs light brown,

G aplowlidge sp. nov.

Head antenna, and abdominal ergites dark brown thorns and legs bright vedow; sternites very pare brown, lateral abdominal membranes white

## 4. GRAULATOTERMES ADMIRARET US LIGHT. Test fig. 5.

Alate.—Head black, median areas of thoranic sterna, legs, and distal segments of antenna yellow; other parts light or dark brown; clypeus lighter than frons, about one-fourth as long as broad; segment III of antenna about as long as II: foutanel white, conspicuous, a three rayed fissure; occlli conspicuous, separated from eye by less than their short diameter, eyes very large, strongly projecting; costal stripe inconspicuous.

# Measurements in millimeters of clutes of Grallatotermes advarabilist L gat.

Longth with wings, male	15.00
Length with wings, female	19.00-21.00
Body length male	9.00
Body longth, female	10.00
Length of forewing	15.20-16.20
Length of forewing with scale	17.00
Width of head with eyes	1.90
Width of head between eyes	1.08
Lougth of head	1.80
Head length to clypeofcontal suture	1.20-1.26
Width of postelypous (maximum)	0.76-0.80
D.ameter of compound eye	0.72
Length of scellus	- r-
Length of fontanel	0.225
Length of pronotung	0.16
Width of pronotum	0.97-1.00
ALL LANGUAGE AND TAXABLE PARTY.	1.90

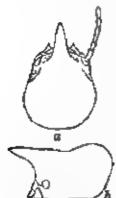
Soldier (fig. 5).—Head, antennes, and abdominal sclerites black brown with reddish tinge; rostrum distally dark reddish; thorax and legs bright yellow, ventral side of abdomen white to light yellow-brown.

Head and rostrum shaped as in fig. 5, dorsal profile concave and slightly sinuous; rostrum short, thick conical (fig. 5, b), uplifted, arising by a very broad base from the otherwise

declivitous froms. Antenna of thirteen segments, considerably longer than head with rostrum.

Measurements in millimeters of soldiers of Grailstaternes admirability Light.

Length	4,30-5 50
Length of head to posterior margin of anternal	
fovecla	1 25
Length of head with restrain	1 80
Width of bead	1 20
Width of pronotum	0.72
Length of prenotum	0 42
Length of hind femur	1 68
Length of hind tibla	2 10



for 5. Graffanserveca våveirabilva Light, head of soldier a. fornal view b. inteen view.

Distribution and biology.—As reported (Light, 1930) this species has been taken once in Panay, twice in Negros, and twice on the Cotabato coast of Mandanao. A large carton nest on a tree trunk was reported in two cases (Panay and Negros). Aside from this, nothing is known of the biology of this striking species.

6. CHALLATBYERMES SPIENDING op. Rev. Text 6g. 6.

Alate.—Unknown

Soldier (fig 6).—Head black, with a deep purplish effect, to dark mallogany; anterior half of restrum readish; antennæ and pronotum brown; other tergites light brown, sternites and legs brownish yellow.

Head large, head and rostrom shaped as in fig. 6. Rostrom short, thick-based, some-

what elevated, dorsal profile concave but less so than in G. admirebilus Light, not sinuous; mandibles thornlike, distal portion bearing a faint vestige of a tooth just below the middle.

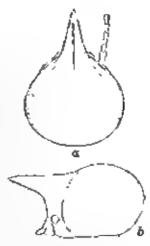
Antennæ of thurteen segments, shorter than in G. adm.rabi-lus slightly longer than head with rostrum; segment III much elongated, more than twice as long as II; III longer than IV; V to XIII subequal, about one-seventh shorter than III. Body relatively weakly chitinized, abdomen long and relatively slender (not "humped" as in G admirability).

Measurements in millimeters, and indices, of a typical soldier of Grallatotermes splendidus sp. not., from the type collection, No. 228.

Length of head and rosteron	1 95
Length of head without rostrum	1.33
Length of rostrum	0.62
Length of antennal segment III	0.20
Length of untonnal segment IV	0.14
Head production	0.27
Height of head	1.00
Width of head	1.41
Length of fere tibis	1.20
Head andex	1.06
Head-rostrum andex	0.47
Head production index	0 22
Leg elongation index	0.90

Systematic position—This striking species, known only from soldiers and workers, differs from the four other species of the genus in (a) its larger size, (b) its shorter antennæ and legs and (c) the elongated, relatively slender abdomen of both soldiers and workers

Distribution and biology.—This species was taken by Light and McGregor from a large carton nest on the rotten stub of a small tree in the swampy tangle near the southwest shore of Lake Casib. This island of andisturbed low-and forest located just across the Pampanga River from Arayat, Luzon, merits careful study from a facual, floristic, and ecologic angle. No record was



Pio. E. Grafiziatermee sylends due sp. nov. head of unidee o dessit view. b. literal view.

made of covered ways, but the relatively weakly chitimzed bodies of workers and soldiers and the relatively short legs make it very improbable that they are day foregers

#### Genus NASL TITERMES Banks

#### Subgramm RAVILANDITERMES Light, 1920.

#### 6. NASUTOTERMES ATRIPENNES (Havilland). Text fig. 1.

Alate.—Dark brown; wings brown-black very thickly haired; postelypeus much shorter than ha f its width. Fontanel large,

three-cornered. Ceellus separated from eye by its short diameter or more (D.agnosis based on Homgron's description of Entermos atripounis Haviland.)

Soldier (fig. 7).—Head light brownish yellow, rosti um darker distally, red-brown; tergites dark brown.

Head and restrum snaped as in fig. 7; dorsal profile distinctly concave, restrum long, thick conical, strongly uplifted. Automize of fourteen segments.

Monuroments in milimeters of a in-ga and a small sudice of Nasatitermes alsocants (Hardond).

and the distance better the desired		
	Levense solonera	Smrtt solder.
Length of head	5.2	4.3
Length of head to posterior margin of an-		
tennal foveoia	1.17	1 08
Length of head with restrum	2.18	2 03
Width of head	1./90	1 12
Leagth of pronotum	0.27	
Width of proputum	0.63	
Length of had tibin	1.80	1.75
Length of abdomen	2.70	2,43

Subgenou WASUTITERMES sen, atr Bunks

The species, must of them new, that are here allocated to this subgenus represent several very distinct types, which may



Pic. 7. Nomble Plants at representation of the blands, bend of solutions a choract view, a lateral view.

ultimately be given subgeneric or generic rank. At present, however, the alates are but little known, and the relations of the species to the other species in the group are not sufficiently well-known to allow satisfactory determination of subgeneric characters.

The differentiation of species in this group presents difficult problems, especially when dependence must be made chiefly on soldier characters. Variation both within the same colony and between colonies is very great. Until very large collections are available which will permit a determination of the nature, extent, and a gnificance of intraspecific variation, the classification of these species must remain unsatis-

factory and to some extent tentative. Oftentimes, however, the decisions are actually more justified than can be brought out by

any method of description as yet available. A certain intangible facies sets certain lots apart as a single species in spite of relatively great variation in size, in head shape, etc., and ever in proportions. Such differences are brought out by the figures of Nasutitermes gracilis Oshima (fig. 8).

	A CAMPAGA
	y to the sold era of the Philippine species of Nanutiterme's Banks sen, ste
2	Head little produced behind, relatively short; without obvious construction boland the unicanal (except N. talintameters).  Head much produced behind, relatively long, pyrifors), with a constriction behind the antennic (fig. 22, a).  Rostrum conical, at least twee as these at base as at middle (fig. 16, b).  Rostrum awi-shaped (cylindrical), less than twee as thick at onse as at middle (fig. 18, a).
3.	as at mode (fig. 18, a)
	trend black, dark brown, or prown with infraction; tip of postrum typically red .
G.	Very small head with restrum less than 1.30 mm long; dersal profite of head distinctly convex
6	Tergites well christized, dark arown, rostrum relatively short and thick, head rostrum index less than 0.60
	Artennal fovenise not visible in dersal view; restruct longer, more stender. N. simulates up now Antennal fovenise visible in dersal view; restruct visible and desal view;
8.	Tergites dark brown, strongly pigmented N parageous (Ostion) Tergites pale to yellow
9.	Larger, head, antenne, etc., orango-brown N. secudial as sp. no. Smaller head light brown; autenne and tergates light
	Tergites very fine restrum reint vely narrow (fig. 15, a and b), from Lason. N. sakinati sp. nov Tergites yellow, restrum thel. (fig. 16, b and c) from southern and lands.
	Very small head, with restrum less than 120 mm long, manuable with vestignal apseal portion (fig. 17, c) ———————————————————————————————————
12	tion of material to drive y long and spinetike
1 104	Layrer, head with restrem more than 160 mm long, head very orand, head index 1.05 or more; apical portion of mandille strongly outenived (fig. 18, c)

Anterolateral margins of head in dorsal view indented by siight but
distinct constriction (fig. 19, a).......... N valutameers is (Oshum).
 No such indentation in a second constraint of the constraint of

 Hond dark smoky brown, particularly at base of rostrion; tergites sendly brown; rostrol hump very completions (fig. 20, c).

N tagiori sp nov

Head light brown; tengites light yellow-brown rostral home not conspicuous N continuents (Oshima)

15 Rostrum long, head-rostrum index more than 0 70.

N megregori (Oshima)

A. constructiones up. nov

Head orange to orange-brown; rostrum not durkened, at most reddish tengi es pale yellow or light brown, not strongly chitinized construction not very conspicuous.

17 Construct on conspicuous, anteroventral corners of head capsule laring (fig. 23 e); mandible with oblique sides, apical portion about one third as long as basal portion (fig. 24, c).

N becoming a up. now. Construction unconspicuous; anterovertral econers of head capsule not visible from above (fig. 2s, a), mand be with heart, straight lateral

sile, its aprical portion nearly as long as basal portion (by 24, c). \( \) brevious in nov

? NASUTITERMES GRACILIS (Online). Test fig. 4.

Enternes (Enternes) graelle Osmma, 1916, 1920. Enternes minutas Osmma, 1917 (fide Oshima). Enternes (Rotunditornes) enterierosis Osmma, 1920.

Declate (fig. 8 a) —Head brown, postelypeus and labrum pale yellow, antennæ light brown; pronotum brownish ye low; mesonotum pale yellowish white, metanotum pale yellow; thorax white with lines bordering scientes; tergites chestnut-brown; sternites yellow to golden yellow with lateral brown areas around white muscle marks, head smah, 125 mm wide through eyes; shaped as in fig. 8, a.

Fontanel conspicuous (fig. 8, a), whitish yellow, Y-shaped, flaring anteriorly; slightly longer than occilis.

Orellus elliptical, long diameter less than one-third diameter of eye, separated from eye by about one-half the short diameter of occllus.

Eye large projecting (fig. 8, a); separated from both upper and lower margin of heat by about one-eighth its own diameter

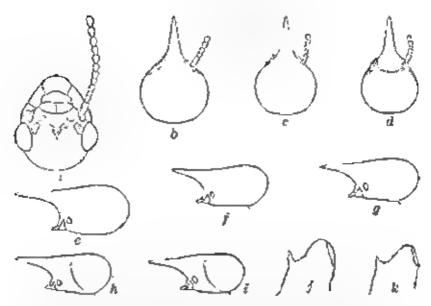


Fig. 8. Anen Reverse gracific (Ochima), a, hand of abito from local Norte in dorant view, h to a, heads of addicts by dorant view to show warmton (h from Phineau, a from Real, d from Rocal Norte from some colour as wh, a to t, hands of addicts in latera as to these variation to from Norte Norte Ratable of Joseph Starty of From Real), a said & tell mandilities of solders: § from Cotalents, the typical form, k from Panay, an extrame variant probably abnormal).

and from posterior margin by about three fifths its own diameter

Antenna of twelve or more segments, III shortest and narrowest, about one-half as wide as distal segments, weakly chit-inized; V small or incompletely separated from VI; II and IV relatively short, subsqual, wider than III or V (when separate), but narrower than more distal segments.

Measurements a millimeters of a declare of Nasutstermes gracific (Oshema), from collection 1236, from Palacian.

Length of body with head	8.58
Length of head	1.45
Length of head enpants	1.08
Width of head capsule	0.93
Width of head with eyes	1.25
Length of pronotum	0.01
Pridth of pronotune	0.04
Diameter of eye	0.49
Long diameter of ocell is	0 17
Short diameter of occilus	0,13
Distance of occilus from eye	0.03

Soldier (fig. 3, b to k) —Head yellow to orange, antenne pale yellow-brown, distal two-thirds of rostrum reddish; body generally pale and slightly chitanzed; tergites pale yellow brown.

Head somewhat variable in shape (fig. 8, b to i), but about as broad as long with flattened or flatly rounded posterior border, rostrom long and narrow, especially in distal half, rostral hump absent (fig. 8, f) or negligible lateral profit straight (fig. 8, a), faintly concave (fig. 8, f), or weakly sinuous (fig. 8, h); head typically depressed anteriorly and roundly elevated behind.

Mandible (fig. 8, 7 and k) different from that of soldiers of the matangensis group in its relatively small free portion and its distally extended molar region.

Measurements in millimators, and indices, of extreme sizes of soutiers of Navitiermes gracilis (Oskima), from collection 665 from Mount Marevolve, Batant Province, Lucon

Length of head and restrum	1.54	1.68
Length of head without rostrum	1 09	1.03
Length of rostrum	0.65	63.0
Head production	0.30	0.30
Height of head	9.76	0.72
Width of head	1,20	1 10
Length of bind tibia	0.83	0.78
Head index	1.10	1.00
Head restrum index	0.60	0.60
Head production Index	0.28	0.29

Variation This is a very widespread, variable species. So considerable was the variation in size and degree of coloration, accompanied in some cases by seeming differences in the shape of mandible of the soldier, that there were originally set aside three new species. Study of variations within groups showed that the characters used in separating these supposed species did not always hold in single cohections. It has seemed wiser, therefore, to leave any finer taxonomic distinctions to later workers to whom more material is available.

The range of size is brought out by fig. 8 b to i, and by the measurements of soldiers from several colonies given below.

Certain colomes from the lower slopes of Mount Mariveles, Bataun Province, Luzon, have considerably durker color, the head being golden yellow to light orange with red rostrum. Here also the tergites are fairly well chitmized and light brown. These colonies are correspondingly larger (see measurements)

below of soldier from collection 680), however, and there seems to be a direct correlation between size and color.

At the other extreme are small forms from floces Norte (No. 1275), Rizal (No. 141), and Pa awan (No. 122), measurements of soldiers of which are given below, which are much lighter in color and charmization than are the soldiers of most of the colonies, and have narrower, somewhat square heads. However, changes in these directions with decreasing size seem characteristic of the nasutes of several species, and hence these differences have been disregarded here, especially since more typical colonies of N. grocals have been found in all these localities.

Measurements of soldiers in millimeters, and indices, from various colonies of Neanthermos gracilis (Och ma).

						-	
				Fran	lae-		
	i	Taguna.	Bitane:	llucon Nario.	13nd	L Alter William	Laguna
Lot No		144	670	1274	48	1337	964
Length of bend and recover	n and a	J 19	1.56	1 50 4	1.54	1.16	16.
Reagable of bond without any	IND -mm.	0.90	0 91	0.81	0.36	0.93	1.04
Longth of gostern	TP-000.	9.68	0.65	■ .9	0.93	n 36	0.55
Mead phothetion.	TEATS.	0.36	41 32	4 65	6 21	0.27	
Height of head.	needs a	0.56	9.61	4.51	9.69	41 60	
Width of head	, ro <sub>10</sub> , ,	0.96	0.09	0.84	1 82	0.22	
Length of fore tibes	Own.	0.15	0.69	B 60	0.49	0.22	
Hraditales		1, 06	0.55	1 00	1 65	1 03	9.56
Bred-corpus index.		0.65	0.75	9.78	9.41	0.63	9 31
Bearl production todes .		0 99	0.28	0.28	0.23	9 31	4 25
Log clongation index		0.83	0.54	0.74	0.78	4 78	0.73

Systematic position.—This is the only Philippine nasate whose soldier has a yellow head and a conical restrum. It seems most closely related to N parameters (Holmgren), but is distinctly larger.

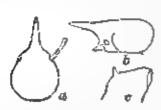
Distribution and biology.— This is one of the common species, occurring twenty times in the collection from localities as far apart as Hocos Norte Province, Luzon, on the one hand, and Sir J. Brooke Point, in southern Palawan, and Cotabate Province, Mindanao, on the other—Other regions represented are Rizal, Bataan, Leguna, and Tayabas Provinces in Luzon, Tablas Island, and Culas. In Antique Province, Caray—It is especially abindant on the slopes of Mounts Mariveles and Maquiling.

Naertitermes quaeits builds extensive covered ways, over dead wood of trees and shrubs and even over deserted buildings. Taylor reported an exposed carton nest for a colony taken on Tablas Island and a subterranean carton nest for one taken at 300 meters' altitude on Mount Maguching.

#### 3. NASUTITERMES MOLLIS sp. nov- Text Sg. 9.

Alate.-Urknown

Soldier.—Head amony yellow-brown behind, darker along sides and in front; rostrom proximally burnt umber, distally



km 9. Amenistremen modes with war- nother, a, bend in decsal view 4. head in interal water, c. left mondible.

reddish; abdominal tergites pale smoky brown; note pale yellow with faint smoky tinge; other parts pale whitish yellow. Head and rostrum shared as in fig. 9, a and b dorsal profile distinctly convex, with a concavity at base of rostrum due to a slight constriction. Head covered with a dense coat of slender whitish hairs. Anienne of eleven segments, about two-thirds length of head with rostrum.

Measurement, in millimeters, and indices, of typical saidiers of Nasutite-mes mollis sp. nov., from the type collect on, No. 1181, from Cotabalo Proince, Vindanao.

				_
Lingth of head and root up:		1 25	1 25	1.22 4
length of head exchant controls		0.28	6.15	4.61
Longth of on rum .		0.45	0.44	
Read production.		0 22	0.22:	0 48
Reight of head		0.45	n 43	0 24
Width of bond.		2 14	0 72 1	
Longth of tible	-	4.57	0.40	III Ku
Head Index		1 05,	-	0.54
Mend-rostrom lodes		# 56	0 36	1 00
Mead production takes			0.04	O 50
Log Magation andra		1 1 24	0 29	4 4-
_		0.00	4 64	0.67

Distribution and biology.—The single collection (No. 1131) was taken by E. H. Taylor "in a dead tree" on Luan River, Cotabate Province, Mindanso.

Systematic position.—The minute size and small number of antennal segments associated with the heavy harring of the head and the relatively long narrowly conscal restrum set this species apart from all other Oriental species of this genus.

5. NASUTITERMES EUZONE CS (Dak ma) Text fig. 10.

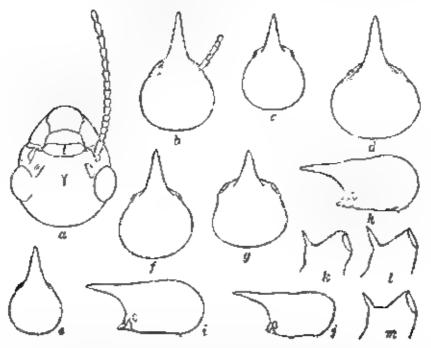
Sutermes (Gradiototermes) In. magus Osmma, 1914, 1918, 1928

Eutermes (Enterpera) manifensis Osmina, 1916.

Enterwice (Entermen) besepidasencia (Intima 1920.

? Eutermes (Trenervitermes) menadocume Osnima, 1920,

This is the most widespread and the most commonly cocountered of the nasute termites of the Philippines. It seems



\$16. 16. Negatife mean recomment (this impair of head of allote in due of since & to go impair of subdiving the dorsal store in plane wanted on any agent may respect to to go individuals from the same colony, his table, from bland going probably abnormally in to go heads of non-zero in military of adjunctional error to district the majority subdiving probably and same of route and it is not full majority of additional states.

also to be the most variable perhaps due to the large collections available for study. There follows an attempt at a diagnosis of the plate and soldier. These should be considered in the light of the wide variation discussed below. The description of the alate is somewhat more detailed as it has not been previously described.

Alate (fig. 10, a) —About 8 mm long without wings, 15 mm with wings; forewing about 14 mm long. Head dark mahogany

brown, nota yellowish, abdominal tergites brown, abdominal sternites yellow with lateral brown areas, wings pale yellowish brown, velus light brown, radius sector bordered posteriorly by a narrow dark brown stripe separated by a narrow white stripe from a golden zone, which shades into the membrane color.

Head (fig. 10, a) about 1.5 mm wide through the eyes, not greatly narrowed in front. Eyes relatively large, about 0.55 mm in long diameter, but not strongly projecting. Occilius about one-third as long as eye, separated from eye by about half its short diameter, long axis of occilius making an angle of about 45° with the long axis of bead, short axis of occilius nearly vertical, making chitin of head seem to overlie its inner margin. Head with curved, raised, transverse ridge joining occili, succeeded posteriorly by a distinct concavity within the anterior half of which the siender, slithke, yellowish to white fortanel is located in a narrow longitudinal ridge. Antenno of lifteen segments; segments II and III subequal in length. Pronotum faintly concave posteriorly. Diagnosis based on collection 706 from Cavite.

Measurements in millimeters of a typical clave of Nasuttermes Incorrect (Ochima), from collection 706, from Cavite, Lucon.

Length over all	15.40
Length of forewing	14.00
Width of forewing	3.60
Length of head	1.80
Length of head capsule	1.11
Width of head capsule	1.14
Width of head with eyes	
Length of pronotum	1.50
Width of prenotum	0.70
Tone democrates of	1 25
Long diameter of eye	0.55
Short diameter of eye	0.45
Long diameter of accllus	0.20
Short diameter of ocellus	0.14
Distance of ecaltus from eye	
the same age	0.06

Soldier (fig. 10, b to m) — Head mahogany red (brown in fixative) to black; distal half of restrum usually reddish, but black in some colonies; antenax light brown; body weakly chitmized, tergites pale yellow-brown to light brown, depending upon degree of chitinization.

Head variable in shape as brought out under variation, but with certain underlying characteristics; head relatively broad (fig. 10, b), sides rounded; posterior margin flatly rounded;

head distinctly narrowed in front, its sides in dorsal view rounding into the sides of the rostrum. Dorsal profile as seen in lateral view typically sintons (fig. 10, h); a shallow groove, marking morphological junction of head and rostrum, running from front of head just above mandibles obliquely upward and backward, passing in front of antenne and crossing head some distance behind the level of the antennal fovcolæ, where it makes a slight concavity; a slightly raised area between this concavity, in dorsal profile, and the front of the head (the "rostra, hamp," fig. 10, h); rostrum constricted near its base, making a weak concavity between rostral hump and dorsal margin of free portion of rostrum (fig. 10, f); dorsal margin of rostrum usually weakly convex, due to slightly uplifted position of free portion as a whole and slight depression of distal third of free portion.

Antenna of thirteen segments, nearly as long as head with rostrum; segment IV shortest, III nearly twice as long as II.

Measurements in millimotors, and indices, of typical said.ers of Nasutrtermes inconicus (Oshima)

	No. 704.	Pecitype.
Length of head and rostrum	1.74	1,6\$
Length of head without restrum	1.14	0.99
Length of restrum	0.60	0.57
Head production	0,3	6.30
Height of head	0.82	0.66
Width of head	1.17	1.02
Head index	1.02	0.99
Head rostrum index	0.53	0.57
Head production index	0.28	9.30

Worker.- Head dark brown; tergites pale.

Distribution and variation.—Nasutitermes haronicus is by far fine commonest and most widespread nasute termite of the Philippines and perhaps the commonest termite species. We have 188 collections of the species, including one from Ithayat Island in the Batanes, north of I uzon, nearer to Formosa than to Luzon, and one from Sitankai Is and, in the southernmost Tawitawi group, within a few miles of northern Borneo. The others are from many of the islands and provinces between. It is most abundant in Luzon, where it is the only abundant nasute species, yet it has been taken on all the principal islands, save Palawan, namely, Mindoro, Samac, Panay, Negros, Cebu, Leyte, and on several of the smaller ones, as Marinduque, Romblon, Tablas, Dinagat, Basilan, and Jolo. In the Visayas It is more or less

completely replaced as the common masute species by the light brown N. panayensis (Oshima) described below.

The soldiers of N. luzonicus show an extremely wide variation, as is brought out by fig. 10, b to g. So great is this variation that with incomplete collections it would be natural, as the senior author's carlier manuscripts attest, to describe these variants as separate species as Oshima has done. When, however, one finds the extremes of such variation within a single colony, as is often the case, it becomes apparent that it is of no taxonomic significance.

So extreme is this variation that it becomes almost impossible to diagnose the species. Were it not that this is the only common dark-headed species of Nashtitermes and, indeed, the only one save N mollis, N. simulans, and N. Inius, which are smaller and known only from Mindanso and Palawan, its identification would be extremely difficult.

This variation affects size, color of head, degree of chitmization, and color of abdominal sclerites, and especially the relative width of head and the shape and relative length of restrum Collections from certain colonies seem consistently black headed, but some contain ourk- and lighter-headed individuals, while in others all are lighter neaded. In dark individuals the reddish coloration of the distal portion of the restrum tends to be obscured. In very light individuals the distal portion of the restrum is yellowish, rather than red

The head length with restrum, ranges from somewhat less than 1.4 mm (fig. 10, d) to slightly more than 1.8 (fig. 10, c). When this shorter length is combined, as is usually the case, with a narrower head (fig. 10, c) the size difference is striking. The smallest individuals are as a rule lighter and have fewer (12) antennal segments. This suggests that we are dealing here with soldiers which metamorphosed in an earlier instar intergrades complicate the situation, which must want for solution upon careful studies of the life cycle and the developing colony. The University of the Philippines, situated in the center of abundance of the species, is well located for such a study.

The range in size and in relative width of head is illustrated in fig. 10, b to f. Head width in the individuals measured ranges from 0.78 to 1.26 mm and the index obtained by dividing head width by head length with rostician varies from 0.48 to 0.73. It is interesting to note that the maximum spread for this index was found by measuring the extremes of variation

within a single colony (fig. 10, e and f). In spite of the great differences in this index between extreme variants, the index is nearly always between 0.60 and 0.65 for what may be called the typical soldiers (fig. 10, b), which make up by far the larger part of most collections.

While, therefore, there is a very striking range of variation in head size and proportions, the ordinary soldiers present a fairly constant shape and size of head, represented in fig. 10, b and 1. Furthermore, while in some cases the variation seems to be between colonies, in those collections which are fair samples it is found to be intracolonial. Thus, in colony 113, from Balintawac near Manita, four individuals were selected that ranged from 1.38 to 1.68 in length of head with restrum, from 0.78 to 1.10 mm in width of head, and from 0.48 to 0.73 in ratio of width of head to length of head with restrum. It should be said, however, that the individual with the ratio of 0.73 was plainly abnormal (fig. 10, p) as brought out by the hunt, rough rostrum, the peculiarly broad front of the head, and other features. Another soldier in the same collection, apparently normal, had an index of 0.68.

Not only does the head vary in size, shape, and proportions as seen in dorsal view, but the profile in lateral view shows much variation (fig. 10, h to f). This involves several factors; namely, (a) the relative height of the head itself in front and behind (fig. 10, h and f), (b) the relative prominence of the rostral hump (fig. 10, h and f), and (c) the direction of the rostrain, whether slightly uplifted as a whole (fig. 10, f), depressed (fig. 10, h), or neither (fig. 10, f). The rostral hump gives the characteristic singleting appearance to the profile of thus species. The profile becomes distinctly convex when the hump is inconspicuous and the rostrain straight or uplifted (fig. 10, f).

Finally, the restrum itself varies in relation to the head length, in its thickness throughout or at the base, and in its shape. In the more typical individuals the sides of the head curve into the instrum in densal view and the restrum beyond the base is clearly narrowed, giving it concave sides in densal view (fig. 10, b) and a concave lower margin in lateral view (fig. 10, i). Certain individuals, however, show a much-narrowed, slender restrum (fig. 10, j). In others this basal constriction is lacking, giving the restrum a coarser appearance, its margins in densal view being nearly straight lines (fig. 10, c), the concavity of the ventral margin being very slight. Again,

the rostram varies as to the distal portion, in some being straight, but more commonly somewhat bent down as in fig. 10, h, or bent up as in fig. 10, j. Much of the apparent variation in length of rostrum is due to the fact that a thick rostrum looks shorter in either dorsal or lateral view

Systematic position.—Its range, from within sight of Formosa to within sight of Borneo, would suggest that this species would prove to be the same as a Formosan or Bornean species. That it would prove to be cospecific with a Formosan termite seems unlikely, because of the lepth between the Batanes and Formosa and the correlated wide differences in their faunic and florm. It differs from N. takesagoensis, also a member of the matangeness group, which it approaches most closely among the Formosan species, in its much larger alate and in the much more narrowed rostrum.

Nasutitermes Inzonicus will probably be found in Borneo, but it has not been identified with any East Indian species. From both N. matangensis (Holmgren) and N. matangensiformis (Holmgren) it differs in the typically much narrower head and rostrum of the soldier and its much darker color.

Biology.—The conspicuous brown carton nests of this species, built usually on trees, are a characteristic element of the rural or village scene in Luzon. Its rather broad light brown to black-brown runways, constructed of wood fragments and faces, connect the nests with the ground and with the dead wood on which it feeds. Runways are occasionally found on houses, and rarely it stacks the wood of houses, asually when, as on the outskirts of Manila, for example, the cleaning away of trees has reduced the amount of available natural wood.

That the secretions of the cephalic glands furnish a fairly effective defense against true ants seems indicated by the reaction of ants into whose opened nests, or near the openings of whose nests, soldiers and workers were thrown. Workers are sometimes carried away by ants, but soldiers almost never; and ants exhibit signs of disturbance, seemingly of fear apparently induced by an odor from the termites. Ants that do pick up termites seem distressed by secretions, as indicated by vigorous wiping of their mandibles.

10. NASUTTPERMES STATE LANS Sp. nov. Text 60, 11.

Alate. - Unknown.

Soldier.—Head chestnut, lightest at level of antennæ, proximal half of rostrum dark sinoky brown, distal half lighter,

somewhat reddish; tergites, including nota, smoky brown; sternites very pale yellow-brown; kiteral membranes transparent white; antennæ light brown; other parts pale yellow

Head and rostrum shaped as in fig. 11. a to d. Rostral hump prominent with a slight construction at its base; head considerably narrowed in front; antennal fovcolumet visible in dorsal view; head with three or four prominent hairs.

Antenna of thirteen segments rather loss than length of head with rostrum; segment III much longer than II; IV and I about as long as II, not niways completely separated.

Abdomen relatively long and slender, not hamped

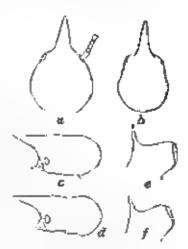


Fig. 11. Nonevolter were simulated by, now, a and b, heads of two soldiers from the same colony, in demant view, to show range of variation is and d, bends of two soldiers from the same calony, in interat view to show range of variation, a and f 100, manifeless of sykless.

Mensurements in millimeters, and Indices, of soldiers of Nasuttermes somelors up, not, from the type collection, No. 1181, from Cotabate Province, Mindager

Length of hea	d old restruct		414		1.45	1 22	1.63
Length of hep-	d without emiteu	in .			1.0%	0 91	0.95
Length of rost	Huto _		,		0.45	6.49	9.54
Rend product	Jvo.,				41 3P	0.27	0.36
Height of hea	4				0.50	0 60	0.57
Width of head				1	0.90	9.84	0,00
Length of fore	the,				0 TR		9.78
Head Index					中 明計	9 92	T Dd
Flya Gernet Pulm	imiles				0.441	0 63	0.55
Mean product	solení da				0 20 F	0.34	0.93
Leg closgation	sinfer				0.57	0.76.1	0.79

Variation.—Color varies from dark opaque chestnut in the large individuals to lighter brown with a yellowish tinge in some

of the smaller ones. Rather wide variation as to width and shape of head in dozsal view, as a so in lateral profile and shape of rostrum, is brought out by fig. 11, a to d

Systematic position.—Nasutitermes simulans is apparently most closely related to Entermes (E) juvanious Holoigran, but differs from it materially in its larger size and darker color.

Distribution and biology.—The single collection, No. 1183, was made by F. H. Taylor, in "rotten wood" on Malanipa Island, Cotabato Province, Mindanao. Nothing is known of its mology.

#### II. NASUTITERALS LATUS ID. NOV. Fort fig. 12.

Alate. - Unknown.

Subtler -- Head chestnut: rostrum praximally dark smoky, distanly reddish; antenne shading from light red at base to

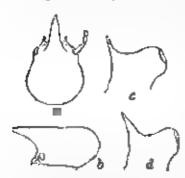


Fig. 12. Manufatormer latter up, novsolder a, head in dered views bhead in lateral otens a and d, left mandfalm.

yellow at tip; tergites and nota smoky brown, pronotum darkest; sterns very pale brown; other parts yellowish.

Head and restrum as in fig. 12, a and b; restrum short, blunt, relatively narrow at base; restrat hump low but distinct; head broad at level of antennae; antennal foveche exposed in dersal view; head with three or four scattered, long, slender bairs

Antennæ of thirteen segments; segments IV and V shortest, subequal; III longer

# Abdomen relatively abort and broad, somewhat humped

Measurements in millimeters, and indices, of soldiers of Nusnederines lature ap norm from the type collection, No. 1736, from Sir J. Bracue Point, Polamon.

4.00	1.10	1 ,3
0.00	9.29 (	n 3a
6.46	9.40	0.49
0 21 1	0.20	0.19
0.61	9.68	0.61
0 50	U DI	0.69
ย คง [	D- (H) 4	0 13
1 02 (	h 04	1 //2
0 73 1	6 mg 1	
V 37	0.05	0.0
0 65	0.64	0 43
		4 112
	0 77	0 77

Systematic nontion.—Nasatitermes latus differs from N. javanious Holmgren in the same way as does N. simulans sp. nov. From N. simulans, which it resembles in color scheme and general size, it differs most strikingly in its generally broader head, the broad flat auterior portion of head making antennal foveolæ visible in dorsal view (fig. 12, a), and in its shorter rostrum. Other differences are the greater height of head, lower rostral hump, and the shorter, thicker abdomon.

Distribution and biology.—The single collection was taken from rotten wood at Sir J Brooke Point, Palawan by E. II. Taylor. Nothing else is known of its biology

#### 13. NASUTTIERMES PANAYENSIS (Oshima) Tent Sec. 13.

Entires (Gradutotermes) prinspensis Oshima, 1920. Entermes (Coylom'ermes) megangari Oshima, 1920 (not of Oshima, 1916).

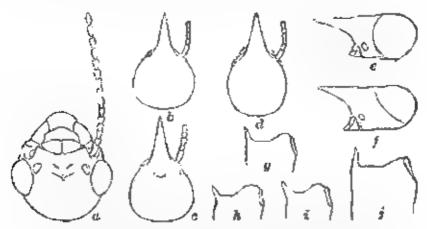


Fig. 13. Verzitt to as a magnetier (Oglobium), a, count of their in storal fiew, b to d, heads of solutions of deviate fiew to from the enclosure from Calasti, Panny, a from a specimen from Thilate, Panny, labeled by Onlines. Confordierness Magnetiers I from which, of course, it differs have madely of from an abnormal solution with thick contents, in the lie Negaria z, head of typical subject in intend water, f head of abnormal soldier space as if its intend were, a in z, left mondifier of soldiers (z from abnormal soldier z and f).

Alate (fig. 13-a). Very similar to N licenseus. Head consistently lighter, slightly smoky light reddish brown; automae yellow-brown; frontal region very light brown; postclypeus light yellow-brown; tergites dark brown, darker than in N licenseus. Fontanci short, nearly triangular (fig. 13, a), much shorter than that of N licenseus. Otherwise as in N, licenseus.

Measurements in millimeters of a typical place of Nasutitormes passayensis (Oskima), from collection 167, from Colu.

Length over 230	15.5
Length of forewing	13.6
Wight of forewing	3.7
Length of head	1-06
Length of head capsule	1.14
Width of head capsule	1.14
Width of head with eyes	1.80
Length of preactum	0.34
Width of pronotum	1.32
Long districter of tye	0.55
Short diameter of eye	0.50
Long diameter of occlus	0.18
Short dimuster of occlus	6.13
Distance of ocellus from eye	0.04

Soldier (fig. 13, b to j). Head much like typical N. Intonicus in shape, but never as wide as in wider individuals of N. Inconcus; with similar variations as to head profile. Rostrum somewhat longer, more slender distally, and more pointed. Head consistently light brown; tergites dark smoky brown, darker than head, and darker than tergites of N. Insonicus, which are much lighter than head. Left mandible (fig. 13, g to i) with short free portion; a depression between it and the me ar surface shallow; lateral and medial surfaces nearly straight.

Measurements in millimeters, and indices, of a typical soldler of Nasktytermes panageness (Oshima), from collection 267, from Cabit.

Length of head and restrum	1.59
Length of head without rostrum	1 94
Length of restruct	0.55
Hend production	9 26
Height of head	0.68
Width of head	0.29
Length of fore tible	0.84
Head Index	0.95
Head-rostrony andex	0.53
Head production index	0.25
Leg elengation index	0.81

Worker.—Much like N. luconious, but head lighter, tergites darker; head light brown, tergites smoky brown.

Variation.—Variation is much less noticeable in N. panayears than in N. luzomens. A paratype collection from Oshima, collected by McGregor at Culasi Panay, shows the greatest range of variation noted, brought out by measurements below. In spite of differences in size, the indices show the proportions to be very similar.

Measurements in millmenters, and indices, of smallest and largest saldiers of Mastitlersus panagensis (Oshima), in paratype collection 1508, from Culasi, Panay

Width of head	0.81	0.91
Length of head with rosteum	1 26	1.52
Length of rostrom	0.40	0.57
Longth of bend capsule	0.87	0.98
Head index with rostrum	6.50	0.60
Hend muck without rostrum	0.93	0.05 -
Rostral index	9.57	0.50

A single soldier in the same vial with a young colony of N. chapmani has been referred to this species because of the obvious similarities in many characters; such as, color of head and pigmentation of scientes. It differs in having a short, basely thickened rostrum (fig. 13, d and f), which led to its being considered at first as representing a new species. The mandible a so is very large with the free portions differently directed (i.g. 12, j). This apparently aberrant soldier represents the greatest extreme of variation so far executived if it is normal variation.

Versurements in millimeters, and indices, of an absormal soldies of Nasatitermes paragensis (Osbima).

Length of head and restrum	1.56
Length of head without restrum	1.05
Length of rostrom	0.51
Head production	0.30
Height of bead	0.66
Width of head	0.96
Length of fore tibes	0.99
Hend index	0.91
Head-rostrum index	0.49
Head production index	0.29
Leg slongation index	0.95

Distribution and hislogy.—This, the common nasute termite of the Visayas, is represented in the collection by forty vials, which might easily have been four hundred. These collections are from the following islands and provinces: Marindaque Island, Tablas Island, Romblon Island, Panay, Negros, Cebu, Camasa Island, Leyte, and Zamboanga. The species is extremely common on Cebu and Negros Islands, and probably olsewhere, where it presents the same picture as does N. Inzonicus in Luzen,

being extremely common in and about the cultivated, thickly populated areas. Its brown runways and carton nests are common sights on hamboo, coco palm, mango, and the other common trees of the region; also on fence posts, telephone poles, and houses. However, it seems to differ from its northern counterpart in its propensity to build over houses and attack decaying wood in them.

Systematic position.—Nasutitermes panayensis is close to N. lizamens from which it differs chiefly in color of soldier and nlate. The head of the soldier is narrower on the average and the rostrum narrower distally and more sharply pointed. The makes of the two species are very close, but that of N. panayensis is much lighter and averages somewhat smaller.

### II. NASUTITERMES BIRE DIANUS ip. nov. Text fig. (c.

Alate (fig. 14 a).—Very close to the alate of N. luzonicus, pronotum somewhat darker, perhaps; fontanel small, inconspicuous (often variable, however, in N. luzonicus). Ofterwise as in N. luzonicus,

Mountements in millimeters of a typical state of Nasultermes meridianus sp. non, from the type collection. No 312 from Zambounga Promuce Ministra.

Length over all	15.2
Length of forewing	13.4
Width of forewang	3.4
Length of head	1.45
Length of head capsule	1.20
Width of head capsule	1.30
Width of head with eyes	1.57
Length of pronotum	0.74
Width of pronotum	1.43
Long niemeter of nye	0.56
Short diumeter of eye	0.48
Long diameter of orellus	
Short diameter of ocell is	0.20
Distance of occilus from oya	0.14
TOTAL STATE OF THE PARTY OF THE	0.06

Soldier (kg. 24, b to i).—Hoad orange-brown; rostrum darker at base, distally reddish; antennæ, thorax, and abdominal tergites yellow with brownish tinge; legs yellow.

Head and rostrum snaped as in fig. 14, b and c. Dorsal profile as in N luzonicus; mand,ble variable (fig. 14, f to  $\varepsilon$ ), but usually with relatively long free portion; lateral margin slightly oblique; anterior sinus relatively short and deep; molar surface snort, succeeded proximally by a short flattened area, beyond which the inner margin is somewhat concave.

60, 1

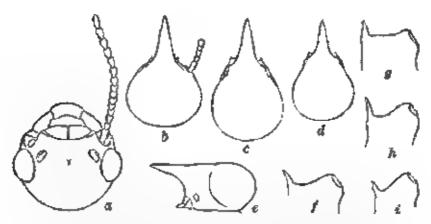


Fig. 14. Normificences morbiforms up, now a head of plate in danget view 5 to d, practs of middless in domain view, to show makes in dies and neutron loss, all from Painwan a, head of middless in agreed view; f 55 5, left mandibles of coldiers to those transition.

Antennie of thirteen segments, nearly as long as head with rostrom.

Measurements in millimeters, and indices of a large soldier of Nasutiteruncy meridians up non, from collection 1/3, from Jolo.

Length of head and restrum	1.80
Longth of head without rostrum	1.14
Length of restruct	0.68
Head production	0.30
Height of head	0.78
Width of head	1.26
Length of fore tibes	1.14
Head index	1.10
Hend töstrum index	0.56
Head production index	0.26
Log elangation index	1.00

Measurements in millimeters, and pidices, of soldiers of Nasititermes meridianus op nov., with nurrower heads than those of the type collection, No. 313

Length of head and restrum	1.80	L71
Length of head without rostrum	1.16	1.05
Length of restrum	0.64	0.00
Head production	0.33	0.30
Height of head	0.76	0.66
Width of head	1.02	1.08
Length of femur	1.19	1,07
Length of hind tiles	L93	1.33
Head andex	9.95	1.02
Head-rostrum index	0.61	0.68
Read production index	0.30	0.30

Measurements in willimeters, and indices, of soldiers of Nasutitormes meridients sp. non., to the smaller head consider and mandiples, from enloction 1228, Palawan.

Length of head and rostrum	1.51	1 51
Length of head without rostrum	0.93	0.93
Length of restrum	0.57	0.58
Head production	0.24	0.24
Height of head	0.08	0.55
Width of head	0.03	0.93
Length of femor	0.78	0.73
Length of hind tibia	1 16	1.07
Length of fore tible	0.84	0.78
Head index	1.00	1 00
Head-rostrum index	0.62	0.62
Head production index	0.26	0.20

Variation.-Very different head types are encountered in the same collection, illustrated by fig. 14, b and c. That these are not two so dier classes is indicated, however, by intergrading individuals (fig. 14, d).

Systematic position .- Nasatitermes moramanus belongs to the matungensis group and is one of a group of very closely related Philippine species including N. luzomeus and N. panayensis. In soldier characters it is quite distinct from N matangensis and N. malangensiformis with types of which we have compared it. From the former it differs in its narrower head, relatively longer rostrum, etc., and from the latter, which it approaches more closely, it differs in being larger and in the lower antennal hump, etc. From N. Inzonicus the alate of N. meridianus can hardly be distinguished, but the brown color of the alate seems characteristic as also the orange tinge of the soldier's head, the greater width of head, the much lighter color of the tergites, and other features. More complete knowledge may ultimately show these species and others of the metangeness group to be true (geographic) subspecies of a single or a very few species.

Distribution and biology.—Of the six vials of this species in the collection one was from Jolo. The others were from Palawan, two from Sir J. Brooke Point and three from Thumb Peak near Iwahig. All were collected by Taylor, who notes that the Jolo collection (313) was from a paper nest in wood. One collection from Sir J. Brooke Point was from runways on a dead log; one of the Thumb Peak collections taken at 2,000 feet was from a paper nest and the other two were from rotten Wood.

II. NASHTITZEMES OBBINAL IS. nov. Text Og 16.

Alate.—Unknown.

Soldier .- Head pale orange-brown, lighter behind; restrum centrally darker, tergites barely pigmented.

Head and rostrum shaped as in fig. 15, a and b, very similar to, but smaller than, N. panayeness; rostrum slightly thicker at base than in the latter species. Mandible as in fig. 15, b.

Antennae pale yellow, of twelve segments, slightly less than length of head with rostrum.

Measurements in milliometers, and indices, of a typical soldier of hasutitermes osumas sp. nov , from the type collection, No. 1809, Lagua.

Longth of head and rectrum	1.47
Length of head without restrum	0.90
Length of restrum	0.57
Head production	0,34
Height of head	0.60
Width of head	0.90
Length of fore thin	0.78
Fload index	1.00
Head-rostrum: index	0.63
Head production index	0.27
Lag alongation index	0.87

Systematic position and distribution.—This species is represented by two collections, from Paete, Laguna Province, Luzon.

each containing a single soldier, which were collected by McGregor. These were sent to McGregor and the senior author by Doctor Oshima as autotypes of N. gracilis. They clearly disagree with Oshima's description and belong with the brownheaded malangeness group of spe. Fn. 18. Nontitermes sehimal up. nov., cres, being nearest to N. panayonsis Oshima from which they differ dis-



molifier; s. head in dorsal view b. head a interal wayer: a left manulities

tenetly in their much smaller size, much shorter hind tibla, and the lack of pigmentation of the abdominal territor

This is the only nasute of this group known from Luzon, and there remains the possibility that it is actually from a southern island and was misplaced in landing. The two codections or hand are probably from the same colony. We take pleasure in naming the species for Dr Masamitso Oshima ploneer student of Philippine termites.

IS, MASUTITERMES CHAPMANI OF BOY, Trut Bg. 16.

Dealate (fig. 10, a).—Head brown, postclypeus and labrum yellowish brown; antenna light brownish yellow, pronotum yellowish brown; mesonotum centrally brownish ivory white:



Fig. 16. Manutitermes chapman ep. 400, e, head of alate in dorsal view, &, bead of solution in derival views o, board of solsold ler.

tergites chestnut-brown; stermics pale yellow, Interally brownish. Head shaped as in fig. 16, a, width through eyes 165 mm

Fontanci (fig. 16, a) prominent, narrowly triangular, flating anteriorly, about three-fourths as long as short diameter of occilos.

Occilius elliptical, long diameter. about one-third the long diameter of eye; separated from eye by about one-third the diameter of ocellus.

Eye separated from lower marg n of head by about one-sixth its own diameter, from upper margin of head by about one-fourth its own diameter, and from posterior due to internal views of tells manufally of margin by about seven tenths its own diameter

Measurements in millimeters of a declate of Nasutilerines chapman. sp. nov., from collection 570, from Negres.

	•
Length of body with head	7.27
Length of head	1.78
Length of head capsule	1.31
Width of head capsule	1,28
Width of head with eyes	LGā
Longth of pronotum	0.79
Width of pronotion	1.49
Long diameter of eye	0,634
Short diameter of eye	0.518
Long diameter of ocellus	0 182
Short diameter of seellus	0.140
Distance of occlies from and	0.046

Soldier (fig. 16, b to d) .-- Head orange-brown; restrum darker at pase and tip; tergites hardly pigmented.

Head and rostrum shaped as in fig. 16, b and c. Head low, only slightly elevated behind, dorsal profile nearly flat, only

faintly sinuous; rostrum very thick near base, tapering gradually to a sharp tip.

Antenna of twelve segments, about two-thirds as long as head with rostrum; segment III longer than II and IV, which are subequal.

Measurements in millimeters, and radices, of a typical soldier of Namittormes chaptean sp. 1000., from collection 045, from Nagros.

Longth of head with restreet	1.53
Length of head without rostrom	0.96
Congth of restrum	0.57
Head production	0.30
Height of head	0.64
Width of head	0.99
Length of fore tibia	0.78
Head index	1 03
Head rostrum ladex	0.59
Head production index	0.81
Leg clongation index	0.81

Systematic position.—Nasutitermes chapmani sp. not. is most closely related to N. panayensis (Oshima) and N. moridianus sp. nov. The slate is larger than that of either species and has relatively larger eyes than has either of these species. In color it is much like N. meridianus, but the large eye distinguishes it, as also the smaller coedius, much more spatisely haired head, and larger, differently shaped pronotum, as well as the orange color of antenne, thorax, etc., in N. meridianus.

The soldier differs from N. panageness in its smaller body with hardly chatnized sclerites, the lighter color of the head, and the narrower head with thick based rostrum. From N. meridianus the soldier differs in the same way as from N. panagensis and in addition in the absence of the characteristic orange color of head, antennæ, sclerites, etc.

Distribution and biology.—Two of the three collections were taken on the Chernos de Negros, above Dumagnete, one by Dr. A. W. Herre, at that time of the Philippine Bureau of Science; the other taken by the semor author and Dr. James Chapman, of Sidman Institute, for whom the species is named, was from a young colony in the dead wood of a limb stub 7 feet above the ground—The third was taken by Dr. E. H. Taylor from wood on the water reservation back of Zamboanga.

IS. NASLTITERMES PARVES TO. ROV. Test Or. 17.

Alate,-Unknown.

Soldier (fig. 17, a to c).-Head gray smoky yellow-brown; rostrum light brown, tergites very faintly pigmented. Very small, less than 3 mm long.



Pro. 13. Namificemes parries ep, nev, soldier a, head in view, a, fest mandible.

Head and rostrum shaped as in fig. 17, a and b. rostral hump prominent; head anteriorly depressed; rostrum narrowed near base with consplexous sharp-tipped hump on front of head on either side of base of rostrum. Head covered with a coat of slender, curved, whitish hairs and docust views b, head a setera a very few, stiff, spinelike hairs. Mandible with a vestigial free portion.

Measurements in withmeters and indices, of a typicus soldier of Nasutitermics pursue sp. not., from the type collection. No. 214, from Jole

Length of head and rustrum	1.20
Length of head without rostrum	0.76
Length of restruct	0.44
Head production	0.27
Height of head	0.48
Width of head	0.69
Length of fore tible	0.54
Head index	0.91
Head-rostrum index	0 57
Head production index	0.35
Leg clongation index	0.71

Remarks.—This very characteristic little species is represented by a single collection, taken by Taylor on Jo.o Island. Its small size, its peculiar head shape, the conspicuous projections on the head on either side of the rostrum, the strongly narrowed base of the rostrum, and the vestigial nature of the free portion of the mandible, as also the 11-segmented automos, seem to distinguish it readily from any other Philippine species. as well as from any other species of the genus known to us.

17. MASUTITERMES ROTUNDUS ap. nov. Text 6g. 18.

Alate.—Unknown

Soldier (fig. 18, a to c) .- Head dul, yellow; rostrum pale reddish; tergites pale yellow, very lightly chitinized.

Head and rostrum shaped as in fig. 18, a and b, dorsal profile concave despite a slight rostral hump; head depressed in front;

rostrum distally slightly uplifted. Hoad with a coat of slender whitish hairs and a few, scattered, spinelike hairs. Left mandible as in fig. 18, a.

Antenna of twelve segments, about five-sevenths as long as head with rostrum, segments II and III subequal.

Measurements is mid-waters and midiacs of a typical soldier of Nasatiternics rotunius op. not., from the type collection, No. 1184, from Cotabato, Mindanae.

Length of head and restrum	1.62
Length of head without restrum	0.96
Length of rostrum	0.60
Head production	0.24
Height of head	0.56
Width of head	1.02
Length of fore tib,a	0.72
Head index	1,00
Head-rostcum jadex	0.69
Head production index	0.25
Log elongation index	0.75

Remarks.—The single collection of this very distinct species was taken by Taylor on the Cotabato coast, Mindanao Nothing is known of its brology.

## 18, RASETTERMES BALINTAUACHNSIS (Oshima) Test Sg. 19.

Entermes (Enternes) bahntanaernsis Ostima, 1917, 1920.

Alate.---Unknown

Soldier (\$6 19, a to c).—Head smoky yellow; rostrum darker, light yellow-brown; tergites pale yellow, very lightly chitinized.

Head and rostrum shaped as in fig. 19, a and b, rostrum long and slender, rostral hump long, conspicuous; constriction some distance behind antenne. Mandible (fig. 19 c) with long apacid portion. Head covered with very minute whitish hairs and scattered spinelike hairs of two sizes.



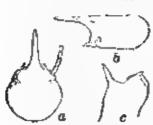
FM. 10. Manuflament runndurup, nov., noldier a. heat in dermi view; h heat kacra, view, c. left manufake

Antennæ of twelve segments, nearly three-fourths as long as head with rostrum; segments if and III shortest, subequal. Measurements in millimeters, and indices, of a typical soldier of Nesatttermes bolintancesum (Oskima), from collection 117, from Tayloy, Read Province, Luzon.

Length of head and rostrum	1.53
Length of head without rostram	0.78
Length of rostrum	0.54
Head product on	0,27
Reight of head	0.58
Wrdth of head	0.78
Length of fore tibra	0.66
Head index	100
Hend-rostram index	0.69
Head production index	0.35
Leg clongation index	0.85

Variation.—Despite some variation in head with and color, the soldiers of the eight collections at hand are very similar. The head index ranges from 0.93 to 1.90 and the head-rostrum index from 0.60 to 0.70.

Systematic position.—This species can be readily distinguished from other known Philippine species with awt-shaped rostra by the very weak constriction of the head (fig. 19, a) and the long free portion of the mandible (fig. 10, c). It approaches the species of the constructories group, but differs in the very slight acture of the construction.



Par 19. Nonethermon boths apecte to decrease Commun. 2016;22; R. B.Zal. None in lateral view e. 10th H. h. manufille,

Distribution and biology—The eight collections are all from central Luzon: Rizal, Laguna, and Balaan Provinces. Three are from Mount Mariveles at an altitude of 1,000 to 5,000 feet, one from Mount Maquiling (2,000 feet), one from Limay, Balaan, and one from Paete, Laguna (autotype). Oshima deserved the species from material from Balintawac Rizal.

It has been encountered most commonly on mountain slopes, which indicates its

association with the original forest. Nothing is known of its biology save that one colony was found by the senior author, attacking the roots of a Heven rubber tree in the grounds of the School of Forestry, near Los Raños, Lagana. The weakened free was blown down, thus exposing the termites

IN NASUTITERMES TAYLORI IS NOT TELL IS. 20.

Alate (fig. 20, a).—Borsal surface dark smoky brown, ventral surface light brown; head dark brown, postelypeus and labrum

pale brown; antennæ brown; pronotum dark brown; mesonotum deep ivory brown, tergites very dark smoky brown; aternites light brown, centrally pale; wing membrane dasky brown; a transparent strip extending from wing scale to posterior third of wing, radios sector deep brown throughout; costal margin brown, subcostal stripe slightly parrower and lighter than radius sector.

Head small, width through eyes 1.32 mm; shaped as in fg. 20, a.

Fontanel gleaming white, conspicuous, narrowly lenticular, at least as long as ocellus. Ocellus elaptical, long diameter not quite twice short diameter; long diameter about half diameter of eye; separated from eye by about long diameter of ocellus.

Eye small, projecting, separated from lower margin of head by about one-third its own diameter, from upper margin of head by more than one-half its diameter, and from posterior margin by more than its own diameter

Measurements in millimeters or a typical alate of Namiliaria's taylori spnov from the type collection. No. 1165 from Cotabate, Mindanae.

COLLOGIA MINISTRA
13.06
11.04
2.94
1.51
1.03
1.08
1.33
0 69
1.12
0.36
0.14
0.12
0.09

Soldier (fig 20, b to f).—Head light smoky yellow-brown, lighter behand; rostrum red, lark at base; tergites brown, heavily chitmized.

Head and restrum shaped as n. fig. 20 b to e, rostrum long, rostral hump conspicuous constriction distinct; a sparse growth of slender whitish hairs on head.

Antenna of twelve or thereen segments, when to ricen segments, II and IV shortest, III twice as long as IV

Monserchouts in millimeters, and indices of a typical sold or of Nasatetermes taylors up new from collection 1158, from Cotobato, Mindanae,

Length of head with restron-	1.63
Length of head without restrum	0.96

0.00

Length of rostrum	B 05
	0.33
Head production	0.62
Height of head	
Width of head	0.93
Length of fore tibin	0.84
	0.95
Head index	0.69
Head-rostrum index	
Head production index	0.34
	0.88
Log cleanation index	2100



Fig. 29 Namilateriary impleri up. nov. a large of state in dorsel view b and d. heads of soldiers, a dorsal view is and e. entable of soldier.

Remarks.-The two collections of this species were taken by Taylor, one on Tatayan Island, off the Cotabate coast of Mindanae, and the other near Caldera, Cotabato. One taken in early April contained numerous fully pigmented dates.

Superficially, the soldiers of this species are close to those of N. castaneus (Oshima), but differ in having larger heads and re-atively shorter rostra, tile rostral index being less than 0.70, while that of N. castaneus is more than 0.75. The propotum also is less heavily chitinized in N. taylors. Differences will be seen in the mand.bles (figs. 20, f, and 21, c), but these may lose significance beach of soldiers in estern view f left when the varietal range is better known.

# ES NASUTITERMES CASTANEUS (Ochima) Trat fig. 71

Enterima (Enternies) costanens Osmina, 1920

Alate.—Unknown.

Soldier (fig. 21, a to c).- Head smoky brownish yellow; rostrum slightly darker at base, reddish distally; tergites brownish yellow, well pigmented.

Head and rostrum shaped as in fig. 21, a and b A few slender whitish bairs on head; rostral hump prominent and long, a sharply depressed saddle at its base; rostrum long and slender.

Antennæ of twelve or thirteen segments; when thirteen segments, If and IV shortest, III twice as long as IV

Measurements in millimeters, and indices of two paratype sadders of Nosutifermen custanens (Online), from collection 1501, from Culasi, Panay

Experience of the section of the sec		
Length of head and restrum	1 56	1.60
Length of head without restrem	0.88	0.5G
Length of restrum		
Head production	0.6%	0.66
	0.27	0.27
Height of head	\$3.0	0.60
Width of head		
	0.93	0.83
Length of fore tiling	0.31	0.78
Head index	1.05	
Head-rostrum index		0.97
Transfer and Australia	0.77	0.77
Hond production Index	0.31	0.31
Leg elongation index		
4.	0.92	0.64

Remarks.—The autotype collection available through the kindness of Doctor Oshima is from Colasi, Panay, and was collected by McGregor. The species may be distinguished from N taylori sp. nov., described above, which it approaches in many ways, chiefly by the relatively longer rostrum and shorter head of the soldier in N. castanens.

# 21. NASSTITERMES MCGREGORI (Oshima).

Entermes (Ceylomitermes) magregor. Osmisia, 1016. p. 36 (sold.se, not imago), pl. 1, fig. 10 noc Entermes (Ceylomitermes, magregori Osh.ma, 1920 (see under N. panayomis Oshima).

Alate Unknown. See discussion below.

Solution — (Derived from Oshima's description and figure.) Head pale brown, rostrum darker; tergites pale yellowish white, lightly chitinized.

Head clongared pear-shaped, with conspicuous constriction; dorsal profile nearly concavo; rostrum slender, "conical," relatively long; head-rostrum index under 0.73 (based on Oshima's measurements).

Antennæ of twelve segments; II to IV subequal.

Measurements in multimeters of a soldler of Nasulitermes megregare (Oshima).

Length of body	4.00
Longth of head with rostrum	1.55
Length of head	0.40
Width of head	0.93
Wasth of pronotury	0.46

Worker.—"Basal portion of clypeus shorter than half the width."

Remarks.—This species was described by Oshima in 1916 on the basis of material collected by McGregor in Laguna Province.

Luzon. He ascribes to it a dealate, which he does not figure but of which he says, "pronotum considerably breader than head" and "anterior wing stumps covering anterior half of the posterior," characters which indicate that he was dealing with a species of the Rhinotermitide, probably Schedorhungtermes sp.

The soldier that he diestrates belongs to the constructoides

group but differs strikingly in the long rostrum.

In 1920 he reported a collection taken by McGregor in Antione Province Panay, as belonging to this species Examination of incividuals from this colony sent to the Bureau of Science and to the semon author as autotypes of N magragore shows them to belong to his N. panayensie.

Oshima placed this species in the subgenus Ceylonitermes It must be admitted that there is a similarity in shape of head



neum (Oskista), noldier, m

between the soldier of N. megrenori and that of Eutermes (Codontermes) eschevicid Holmgren (1911). The soldier of N. megregori lacks the elongated antenna and legs, which characterize the soldier in Contomics and, of more importance, Oshima in his description of the 2) Sandicents code worker states, "basal portion of the cly head to done your, a head peas shorter than half the width," while in larger was a lot man- Holmgren places Coyloudermes in the group of subgenera the workers of which

have a postely peus about as long as half its width ("Clypeobasole der Arbeiter stets etwa so lang wie seine halbe Breite"). In the description of E. (C.) excherichi he anya: "Clypeus gross, aufgettieben, so lang wie seine halbe Breite." We have, therefore, placed the species in the subgenus Nasutitermes sen, str. (== Entermes sen, etc. Holmgren).

# 27, NASUTITEMES CONSTRUCTIONS ID. no., Text fig. 22

Alate.—Unknown

Soldier (fig. 22, a to c).—Head smoky brown, rostrum dark, distally pale reddish; tergites brown, well chitinized

Head and rostrum shaped as in fig. 22, a and b. Head ex panded and greatly produced behind, head constructed some distance behind the autonne; rostrum relatively short, dorsal profile in lateral view concave, rostral hump wanting or only faintly suggested

Mandibles (fig 22, c) with straight or concave sides and a long, sharp, free portion in line with the side.

Antennæ of thirteen segments, somewhat congated, a ightly longer than length of head with rostrum, segments II and IV shortest, subequal; segment III elongated, at least as long as elongated distal segments.

Measurements in willingters, and indices, of three soldiers of Nasathormes constructuous up now, from the type collection, No. 1153, from Zambounga, Mindanao.

	Largest.	Smallert	Average
	· ——		
Longeh of head puck restrons	1.68	1.68	1, 54
Longth of blood without contram.	1 24	1 05 6	3.11
Rength of rootness .	0.48	0.63	0.48
Head productive	9 64	0.10	0.66
If ight of load,	0.72	9.63	0.62
Width of head	, ng	0.87	0.56
Length of fore tites	0.44	0 25	0.84
Read andex	0 65	0.88	0 81
Michael-modernien streifen	0.48	0.49	0 45
Head production undex	0.45	0 40	0.43
eg rlongation index.	0.70	0 2	D. 76

Remarks.—This very distinct species is based on a single collection taken by Taylor in the Caldera Bay Mountains, Zamboanga Province Mindanao. Nothing is known of its biology.

The dark, very markedly constricted head (fig 22, a), swollen behind, and the dark, strongly chitinized tergites serve to distinguish this species from N busings sp. nov. and N, browledges sp. nov.

#### II NASUTITERMES BUSHANCIS 49, nov. Text dg. 21.

Arate.--- Unknown.

Soldier (fig. 23, a to c).—Read orange-yellow, restrain reddish orange; tergites dull yellow, weakly chitmized.

Head and rostrum shaped as in fig. 23, a and b; dorsal profile deeply concave; rostrum somewhat uplifted; constriction not so deep as in N. constricticeps; anteroventral corners flaring (fig. 28, a). Mandible (fig. 23, c) broad, with oblique sides; free apical portion spinchke, much shorter than in N. brevicorns sp. nov. and much longer than in Subultermes marweles sp. nov.

Antenne of thirteen segments, somewhat clongated, about aix-fifths as long as head with rostrum; segment II shortest, III longest, IV and V subequal.

Measurements in millimeters, and indices, of a typical soldier of Nasytitermes busyange up, nov., from the type collection. No. 1216, from Busuanga Island.

Length of head and rostrum	1.52
Longth of head without renteum	104
Length of rostrum	0.48
Head production	0.32
Height of head	0.57
Waith of head	0.87
Length of fore tibin	0.86
Head index	0.84
Head-restrum index	0.46
Head production index	0.31
Leg elongation index	0.63



Romarks.-The single collection on which this species is based was taken by Taylor under coconut débris at Coron on Busunaga Ishad, of the Calamianes group, between Mindoro and the northern end of Palanan. Nothing is known of its biology

This species is distinguished from nearly related species by the widely flaring antereventral corners of the head capsule (fig. 23, a), the oblique sides of

Pre 22 Numbers of the restrict the mundible (fig. 23, c), and other charbeens up, now, soldier; o, actors. dibia.

in interal views o, ask man, 24. HASUTITERRIES BREVICORVIS sp. nov. Test Su. 24.

# Alate, -- Unknown.

Soldier (ng. 34 a to c) -Head and rostrom orange-brown; tergites light smoky brown, well chitmized.

Head and restrum shaped as in fig. 24, a to d; head pearshaped, strongly narrowed in front, anteroventra, corners flaring; head elevated and greatly produced behind, depressed in front; restrum short, uplifted; dorsal profile generally concave, but sinuous due to the low restral hump. Mandible (fig. 24, e) with straight lateral side and usually long free portion.

Antennas of thirteen segments, somewhat elongated, fivefourths as long as head with rostrum, segment III longest, II and IV smallest, subequal.

Measurements in millimeters, and indices, of a typical soldier of Nasutitermes brevicarnic sp. nov. from the type collection, No. 1/8", from Catabato, Mindanae

Township of head and a second	
Length of head and restrant	1.44
Length of head without rostrum	0.98
Length of rostrum	0.46
Head production	
	0.89
Height of head	0.68
Width of bend	
	<b>0</b> .90
Length of fore tibia	0.84
Head ondex	
	0.92
Head-rostrum index	0.46
Head preduction index	***
	●.40
Leg clongation index	.2ಕ

Remarks.— Two collections of this species were taken by Taylor in Cotabato Province, Mindanao. Nothing is known of its biology.

The relatively very short restrum, giving a head index of less than 0.50, and the very long apreal portion of the mandible (fig. 24,  $\sigma$ , distinguish this species. Variation in width of head is brought out in fig. 24,  $\sigma$  and  $\theta$ , and in shape of head in interal view in fig. 24,  $\sigma$  and  $\theta$ .

# Genus SUBULITERMES Hologren

25. SUBULITERMES MARIVELES OF BOY. Took fig. 25.

Alute (pg. 25, a) —Head very dark black-brown, postelypeus light brown, lab um very pale, antenna brown, pronoun

rusty brown; mesonotum centrally ivory brown; tergites dark brown; sternites pale yellow-brown, iaterady smoky brown, wing membrane pale krown, veins brown, radius sector continuous with dark brown stripe of same width subcostal stripe brownsh yellow, about as wide as radius sector, separated from brown stripe by an irregular clear line; a narrow area between radius sector and costa.

Head small; width through eyes 1.32 mm; head shaped as in fig. 25, a.

Fontane. (fig. 25, a) broad, abruptly flaring anteriorly, terminating in two sharp lateral points; nearly twice as long as occlius.



Fis 25. Americkerries becomes an ap. more, subject a, head in identity views b, head to internal views, c. feet mandatile.

Ocellus circular, diameter about one-third diameter of eye; separated from eye by about one and one-half times diameter of neelius.

Eye small, separated from lower margin of head by about one fourth its diameter, from upper margin of head by more than one-half its diameter, and from poste for margin by more than its own diameter.

Antennæ of fourteen or fifteen segments: III smaliest, very short and narrow; II and IV subequal; distal segments somewhat clongated.

Pronotom longer than half its breadth, anterolateral corners broadly rounded; sides converging posteriorly, rounding slightly into nearly straight, medially slightly concave, posterior border.

Measurements in millimeters of a typical alate of Subulitermes marrieles up, not from the type collect on, No. 684, from Mount Marineles, Bataan Province, Lucon

Length over all	14 72
Length of forewing	13 20
Whith of forewing	2.26
Length of head	1 54
Length of head capsule	1 00
Width of head capsule	0.07
Width of head with eyes	1 25
Length of pronotum	0.71
Width of procedure	1.07
Diameter of eye	0.34
Long dianicter of ocellus	0.15
Short diameter of occilian	0.11
Distance of ecollus from eye	0.11

Soldier (fig. 25 b to d).—Head light smoky brown; restrum dark smoky brown, with faintly reddish tip; tergites very pale yellow-brown, very slightly chitinized.

Head and restrum shaped as in fig. 25, b and c, dorsal profile sinuous, restral hump distinct, low and long, set off by grooves from somewhat swellen posterior portion of head and anteriorly from somewhat straight ventral margin of the head. Head with sparse growth of short whitish hairs

Mandible (fig. 25, d) long and narrow, with very small free portion and auterorly projecting molar region.

Antennæ of tweeve acgments, not clongated, slightly shorter than length of head with rostrum; segments II and III shortest subequal. Beasurements in millioneters, and indices, of a typical soldier of Subiditermus marireles up, not, from the type collection, No 484 from Mount Marireles, Baluan Province, Lucon

Length of head and restruct	1.45
Length of head without restrum	0.04
Length of restrain	
Head production	0.61
Height of head	0.30
	0.57
Width of head	13.0
Length of tibia	0.75
Dead index	0.80
Head-restram index	0.51
Head production index	
Log clongation index	0.02
male standings and car	63.0

Remarks.-The three collections are all from the slopes of Mount Mariveles at 1,000 and 1,500 feet altitude, collected by

McGregor and Light, June 21, 1921. at which time mature plates were found in one colony. Nothing is known of the biology.

The soldier of this species is easily distinguished from the other Philippine species with long pear-shaped heads, short rostra, and a more or less distinct construction behind the antennæ by the meanspicuous nature of the constriction, the lack of clongation of the antennae, the short antennal segment III, and the ves- gen, 24 Constitution breckership aptigeal nature of the apical portion of the mandiule

innet, entitiere e unit b, begift in derent view, a and of becale on boosts. views of left manufalke

The vestignal nature of the mandibles, together with the fact that the postclypeus of the worker is about one-half as long as wide, seems to necessitate placing this species in the genus Subnatermes pending a more careful investigation of the groups of misute termites.

## 26. SUBULITERMES MINDAMENSIS op. opr. Test Sc. 26.

Alate (ng. 26 a) .- Genevally dark brown; head very dark brown, postelypeus and labrum pale yellow-brown; antennæ brown; pronotum rusty brown; mesonotum ivory brown; fergites dark brown; sternites brown, centrally pale; wing membrane dusky brown, radius sector deep brown, costai margin

brown, subcostal stripe barely visible; cubitus and median separated by a narrow clear area extending from wing scale to central point of wing.

Head small, width through eyes 1.02 mm; head shaped as in

fig 26, a



Pro. 25. Subul. report that ritteres up. none, brad of plate in dereal view, b. head noldier in interel view, d. left manuible of suldier.

Fontanel narrow, club-shaped, widest posteriorly; about two thirds as long as occilius.

Occilus nearly circular, slightly less than one-th.rd thameter of ever separated from eye by diam. eter of occlius or somewhat more.

Eye small, separated from the lower margin of head by about one-fourth its own diameter, from upper margin of head by about one-third its own diameter, and from posterior margin by about its own chameter.

Antennæ of thirteen segments. III typically shortest.

Pronotum long, sides convergof soldier in doma, view; a best of ing strongly posteriorly to carve into strongly bilobed posterior margin.

Measurements in millimeters of a top cal alate of Subuliformes mindaneszes sp. nos., from the type collection, No. 1145, from Colubate, Mindange.

W 17	
I engilt over all	21.03
Length of forewing	9.02
Width of forewing	2,62
Length of head	
Length of head capsula	2 13
Width of head capsalo	0.82
Width of head with oyen	0.57
THE OF BORD WICE CAGE	1.04
Largely of proposition	Q <sub>rv</sub> B
Width of pronotum	0.84
Diameter of tye	0.285
Lung distreter of ocellus	
Short diameter of orallus	0.10
Distance of acellus from eye	80.0
areand would the	AU.O

Soldier (fig. 26, b to d) .- Head light smoky yellow: rostrum dark (reddish) over entire length; tergites pale yellow, very slightly chitinized.

Head and rostrum shaped as in fig 26, b and c, head broad posteriorly, converging anteriorly, without lateral constriction; profile of head convex due to anterior depression and weak restral hamp; rostrum short, awl-shaped; an inconspicuous hump on either side of head near base of rostrum; mandible (fig. 26, d) extremely reduced, apical portion obsolete and that side of mandible reduced.

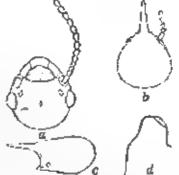
Antennæ of eleven segments, about two-thirds as long as head with rostrum.

Measurements in wildracters, and indices, of a soldier of Subulturnes mindanensis ap. nev., from collection 1144, Cotabate Province, Madange,

Table	CAROLEL TITE CHECK
Length of head and rostrum	1.41
Length of head without routeum	0.87
Length of rostrum	0.54
Head production	0.24
Height of head	0.59
Width of head	0.87
Length of fore Libra	0.72
Head depression	0.12
Head index	1.00
Hent-restrum index	0.62
Head production index	0.28
Lag olongal on index	
Hend height adex	0.83
Head depression index	0.68
are achievator titles	0.20

Remarks .- There are three collections of this species, all made by Taylor at different localities in Cotabato Province, Mindamao, en April. 1923. Two of these contain numerous slates. Nothing is known of their biology.

The species is readily distinguished from all other species known to us by the vestigial mandible of the sokher, which not only lacks a free portion, but which has the anterolateral region of the mand, ble Fig. 36. Substitution in admirant up reduced. This, with the long swol len postc.ypeus of the worker, places the species in Subulitermes. Without dissection the soldier somewhat



nov. e. head of plate in dernal view, b, head of soluter in derival view of head of soluter a lateral view of left mendiate of soldier

resembles that of N. balintanaccusis (Oshima), from which it may be distinguished by the depressed head with convex lateral profile as well as by the shorter costrain

- Fig. 11 Nosetitermes simulars sp. nov., a and b, kends of two soldiers from the same colony, in dorsal view, to show range of variation, a and d, heads of two soldiers from the same colony, in lateral view, to show range of variation; a and f, left mandibles of soldiers.
  - Nasutifernies totics sp. nov., zoldier, a, head in dorsal view; b, head in lateral view; c and d, laft mandables.
  - 13. Nasutitermes princepouse (Oshima); a, head of alate in dorsal view, b to d, heads of soldiers in dorsal view (b from an autotype from Calasi, Panny; e from a specimen from Tibino, Panny labeled by Oshima 'Cogloni, ermes Magnegori' from which, of course, it differs very widely; d from an abnormal soldier with thick restrom, taken in Negros); e, head of typical soldier in lateral view, f head of aproximal soldier (same as d) in lateral view, g to j, left, mandibles of soldiers (j from abnormal solution d and f)
  - 14. Nasutitormes meridamus sp. nov ; a head of alate in dorsal view b to d, heads of soldiers in dorsal view, to show range in a read proportions, all from Falawan; c, head of soldier in lateral view. f to i, left mandibles of soldiers to show variation.
  - Nasktitermen ouhiman up. nov., nother; n, head in dorsal view; b, head in lateral view; c, left mandible,
  - 16. Nasatitermes chapman sp. nov : a, head of slate in derest view, b, head of soldier in derest view, c, head of soldier in lateral view, d, left mandable of soldier
  - 17 Nontifermes purvus sp. nov. soldier; a head in dorsel view; b, head in lateral view, c, left mandible.
  - Nasatziermes rotundus ap. nov., soldier; a, head in dorsal view;
     b, head in lateral view; c, left mandible
  - Nosviticemes balintauacousis (Oshima), soldier: a, head in dorsal view; b, head in lateral view; c, left mandible.
  - 20. Nasutiterines taylori up. nov.; a, head of alate in dorsol view; b and d, heads of sold ers in dorsol view; c and c, heads of soldiers in lateral view, f, left manditum of soldier.
  - Nashtstormes custaneus (Oahlma , soldier; e. head in dorsal view;
     bead in lateral view; e. left mandible.
  - 22. hashfilermes constrictions sp. nov. soldler; a, head in dersal view; b, head in lateral view, c, left mandible
  - 28. Nasatitormen bushangse sp. nov., soldier; a, head in dorsal view, b, head in lateral view; c, left mandible.
  - Narattermos brevicarms sp. nov., soldiors; a and b, hends in dorsal view, c and d, heads in lateral view; c, left mondible.
  - 25 Subulifermes marireles sp. nov : a. nend of alate in dorsal view; b, nead of soldier in dorsal view; c, head of soldier in lateral view; d, left mandible of soldier
  - 26. Subniticemes mindaneusis sp. nov.; a, head of slate in dorsal view, b, head of soldier in dorsal view, c, head of soldier in lateral view; d, loft mandible of soldier.

### BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for raview.

### RECEIVED

#### MAY 1 7020

American society for testing materials. Index to A. S. T. M. standards and tentat ve standards. Philadelphia, Pa., The Society 1936, 159 pp.

Hinnand, G. E. Fastern industrialization and its effect on the west with special reference to Great Britain and Japon. London, Oxford un v prem, 1985. xxil + 395 pp. tables, Price, \$7.

MACEACHERN, MALCOLA T Hospital organization and management Chiongo, Physicians record co., 1935. xx.v + 944 pp., front., plates, tables, Sapre. forms. Price, 87.80

NAVARRO BURRAS, P. Carso general de matemáticas aplicados a la fisica, a la química y a las ciencias naturales explicado en la facultad de ciencias de Madrid. Madrid, C. Bermojo, 1036.

SINHA, BASANTI CHARAN Acadesis and the distotic treatment of discusses. Calcutte, The Swasthya Sangha, 1935.

STORLEY, JAMES. Stor and telescopes. N. Y and London Hurper, 1936, xili + 319 pp., front., illus., p ates. Price. \$3.

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Buston, Ostan W. A hibriography on the cutting of metals. Pt. 11. Ann Arbor, Michigan, Edward brothers, 1935. 202 pp., tables. Price, \$2.50.

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HALL, S.r DANIEL, [and others]. The frustration of scence London, Allen & Unwig, 1935. 144 pp. Price, \$1.

HAMPIONO, T. E. Infortume of the urinary tract. London, H. E. Lewis & co., 1938. z + 250 pp. Price, \$2.75.

KLINESPIE OFFO. Race differences. N. Y. and London, Harper, 1935. ix + 367 pp., tables. Price, \$2.50.

Moneyo, J. L. Who shall survive. A new approach to the problem of human interrelations. Washington, D. C. Nervous and mental discusse publishing on, 1935. xvi + 427 pp., illus, chages. Price, \$4

PACIJAN, D. Tumeurs de l'encéphale, contributions a l'etude anatemec mique des tameros introcramennes et da repérage venir coloire. Paris, Masson et cie, 1925. il 4 212 pp., i fus. Price, \$1.25.

821

SCHULTZ, THEODORE W. Vanishing farm markets and our world trace Boston, N. Y., 1935. 41 pp., diagres. Price, \$0.50.

STEPHENSON, THOMAS. Incompatibility in prescriptions and how to avoid it with a dictionary of incompatibilities. 4th cd., rev. and cnl. Edinburgh, The Prescriber offices, 1935. vii + 62 pp. Price, \$2.

#### REVIEWS

Men, Money and Molecules. By Williams Haynes. Boubleday, Doran & Co., New York, 1936, 186 pp. Price, \$1 50.

This book gives a very interesting and popular account of the development of the American chemical industry.

The average person scarcely realizes the magnitude of this industry, for the value of chemicals produced annually in the United States is greater than the combined annual production of Germany, England, France, Italy, Japan, and Russia.

The United States has abundant supplies of raw materials, and there are now in operation the most complicated modern types of chemical enterprises, such as the manufacture of dyes, fixed nitrogen, medicinal compounds, and numerous other products.

The World War awakened the pullic to the importance of chemicals. The spread of chemical processes through most industries has brought the manufacture of chemicals from an inconspicuous and wholly auxiliary position to a pivotal place as the supplier of materials that have become prime necessities of all manufacturing.

All sorts of raw materials are likely to be appraised upon the hasis of their chemical constituents as the chemicalization of industries proceeds.

This is, indeed, a very interesting and instructive little book that should be widely read. It also contains an American chemical chronology beginning with the production of wood far and potash in Virginia in 1608.—A. P. W

Labar Preumonia and Serum Therapy. By F. T. Lord and Roderick Hoffron. The Commonwealth Fund, New York, 1930. 21 pp. Price, 31.

This is a handbook of well-established pacteriological and immunological principles as applied to the diagnosis and treatment of lobar pneumonia in Massachusetts. The authors' experience in the successful application of antipneumococcus serum therapy in the state since 1931 prompts them to advocate its wider use in general medical practice. For this purpose the rapid typing and early administration of the type specific antipneumococcus serum is essential. The decage and the technic of administration

of the serum are given in detai. As in all serotherapy, proper selection of patients statable for serum treatment through personal inquiry and sensitivity tests is emphasized as a precaution against troublesome and possibly fatal altergic reactions

In the authors' experience timely and proper administration of the antiserum treatment results in marked improvement within eight to twenty-four hours after the initial injection, particularly in type I. Cyanosis and dyspines are relieved, the temperature drops, and the patient becomes clearer mentally. The course of the neute symptoms in shortened and made in liter. Racterizative is prevented or, if present, is readily checked. The mortality rate is reduced from 25 to 111 per cent in type I infections and from 41 to 272 per cent in type II. The high fatality rate in bacterization cases is also considerably lowered.

Since, at present, effective serum therapy in preumonia is confined to type I and II infections (the causative agents in about 60 per cent of lobar pneumonia cases in temperate climates) this method of treatment is of little value in the Philippines, where the offending organism in 80 per cent of pneumonia patients is of the heterogenous type IV. — W. V.

Hosp tal Organization and Management. By M. T. Machachero, Physicans' Record Co., Charago, 1035, 944 pp., Elaz. Py ec. \$7.50

Although Doctor MacEachern's qualifications by training and experience in hospital organization and management are not known, after a careful perusal of his book he reveals himself to us as one possessing a rich background. For the first time we have the advantage of having for our guidance a vast array of facts on all phases of hospital organization and management thoroughly and clearly presented in a single volume. Heretofore we have had texts covering only some phases of hospital organization and management superficially discussed and of very limited scope.

Of special interest in this book is the broad discussion of the principles of organization with the corresponding charts which should appeal not only to hospital directors, superintendents, doctors, nurses, and other types of personnel, but even to the patients and the public, because of the vividness with which they picture the proper relationship that should exist between the persons that manage the hospital and those that they are supposed to serve. This together with the chapter on hospital etnics will remove many of the mistaken conceptions of responsibility and authority held by many hospital workers.

Two special features that will be found of great belp by hospital personnel or would-be hospital organizers and administrators are the lists of the needed equipment, supplies, and materials for each hospital department, and the suggested diagram of certain services. There is no gainsaying the fact that we have experienced much waste of money and effort with the consequent ineffectiveness and inefficiency in organizing and administering hospitals without guidance coming from experience based upon seen analytic investigation, such as shown in Doctor Mac-Bachern's book.

Doctor MacEachern lays emphasis on many modern phases of hospital organization and administration heretofore untouched. His work is exhaustive, from the early history to the twentieth century hospital, and covers such topics as the need for survey, women's auxiliary, the admitting department and it psychology, and the out-patient department. The medical social service, ethics, and public education are needed innovations in a progres sive hospital, which receive as yet very negligible attention in the Philippines. These departments should be considered essential and integral parts of the hospital and should receive as much attention us other parts if the hospital is to keep pace with progressive medicine and advancing civilization.—A. P. V

Pre-Medical Care. Comp. & ed by E. C. Buchler Noble and Noble, New York, 1935. 300 pp. Price, \$2.

The book presents an exhaustive analysis of the pres and cons of state medicine. It is a series of articles which try to justify state medicine and, at the same time, present the disadvantages of the system. In places where health insurance has been established, the result of this system is very encouraging. On the other hand, the dark side of pre-medical care, as practiced, is the pauperization of the medical profession.

The point stressed in the book is the inability of the people to pay for adequate, proficient medical service. Hence, by group practice, the results of medical researches that have been found through years of individual effort among the members of the medical profession will find practical application to suffering humanity. Against it is the fact that, with socialized medicine, the free choice of physicians is entirely chiminated. On the whole, the book is a complete, practical presentation of socialized medicine, presenting both the advantages and the disadvantages of the system and calling attention to the point that the people are becoming less and less able to spend directly for efficient

medical service, including hospitalization, dentistry, and nursing care.

The book is worth while reading, because it is not a passionate plea for one system or another. It gives the reader an opportunity to weigh the facts presented with an open mind.—A. V

The Physiology of Demestic Animals By H H Dolors, Comstock Publishing Co., Ithaca, New York, 3d rev ed., 1975. 643 pp., illus. Price, \$6.

For years there has been a great need for an up-to-date English textbook on votermary physiology, and the appearance of Professor Dukes's book is most gratifying

The book deals with the physiclogy of all domestic animals, including fowls, giving valuable data and results of the latest scientific researches and investigations. It is backed by the author a experience and observations of more than a decade as a teacher and realous researcher. The subject matter is divided into eleven parts of forty chapters. The introductory chapter written by Prof E. A. Hewatt, of Iowa State College treats of the physicochemical basis of various phenomena involved in body functions. The succeeding chapters deal with the functional characteristics of the blood and lymph, the various systems of organs and tissues, and metabolism. The last part, which gives the physiology of reproduction, has been contributed by Prof. G. W. McNutt, of Washington State Veterinary College. The discussions of the physiology of the digestive tract, the endocrine glands, and the reproductive organs are especially interesting and practical.

The book is profusely illustrated. It also abounds in citations of authorities in the field of physiology. The comprehensive lists of references at the end of each part afford the interested atudent a lead into a more detailed survey of the literature on a given topic. The subject matter is so acranged that for purposes of class-room instruction assignment could start with anyone of the eleven parts, without danger of materially impairing the value of the text.

While the book deals in large measure with the theoretical expositions of the numbered laws of the functions of the different tusines and organs of the animal body, much attention is also devoted to the practical or applied aspects of the subject matter dealt with. Throughout the book the author and his collaborators have expressed their thoughts clearly and concisely, making it easy for the student to group the facts presented. The book will be found very useful not only by the

veterinary student and practitioner for whom it has been written primarily, but also by the student of animal husbandry, animal natrition, and comparative physiology.—A. C. G

The World Agricultural Satuation in 1933-1934 International Institute of Agriculture, Rome. 502 pp. Price, \$2.50

A periodical publication of the International Institute of Agriculture, the 500-page book presents an extensive survey of the general trends of the present economic situation in world agriculture and of the agricultural policies and conditions in different countries. Statistical tables on production, exports, imports, and index numbers of prices of various products are widely distributed in the book with their corresponding annotations and explanations.

The first part of the economic commentary deals with the unversal conditions and problems in agriculture—national planning and world economy, movements of prices, notes on market conditions, and coordination of the various forms of economic activities with the aim in view of achieving economic balance and prosperity. Mention is made of the interventions undertaken by the governments of different countries in behalf of agricultural adjustment, prominent among which are the Italian Corporations Law of 1934, the Five Year Plan of Soviet Russia, and the Agricultural Adjustment Act of the Roosevelt administration. The principal commercial products of the world are discussed comparatively with the preceding years in regard to acreage, production, yield per hectare, and movement of prices represented in the form of index numbers based on the average prices of 1927.

The second part of the volume is a detailed study of the conditions and policies in thirty important agricultural countries from Australia to the United States. Under each country are two separate chapters dealing with government measures of farm relief and with the economic conditions of agriculture. Emphasis is laid on the various steps made by the government of each country on behalf of the farmer and on the fluctuations in production and prices and their effects on the general agricultural situation.—L. Ma. G.

Tumoura de l'Encephale. Contributions à l'Étude Anatomochialque des Tumeura Intra-cranicanes et du Reperage Ventriculaire. Par D. Paulian Masson et Cia., Paris, 1935. 213 pp. Price, \$1.25.

Approximately the first third of this monograph is devoted to an op-to-date account of brain tumors, with particular reference

to their classification, description, and diagnosis, and with a detailed description of the different technics employed in ventraculography and the interpretation of the ventriculagraphic pic-The chapter on ventriculography is quite fully presented. The author adopts the classification of brain tumors most generally followed to-day-that is, one based on embryology remaining part of the work is devoted to a chaica, and anatomo-pathologic study of the forty-sex cases of brain timors which the author had seen in his own service during the last ten years. Therey-six of the cases were primary tumors of the glioma group, and the rest were either metastatic cancers princivally, or tuterculomas of the cerebrum and cerebeaum. The text is illustrated with 189 cuts, chiefly microscopic sections of the author's personal cases. Curiously enough, there were as many male as female nationts. The author fitths a wide variation in the symptomatology of brain tumors, and foresees a remaking of our conceptions of the physiology of the brain and of the nerve centers, not only with respect to the better-known brain areas, but with respect to its supposedly selent areas.

Unfortunately, most of the author's patients presented such an advanced condition as to proclude successful intervention in all but a small number of them. The failure of the interventions has more than convinced the author as to the great need of early diagnosis and of operating at the opportune time; that is, during theure chirugicals.

It would have added to the value of the monograph if the author had discussed each case as presented; also it would have facilitated identification if the illustrations were cited parenthetically in the text or labeled with the respective case numbers

In the preface Dr. Clavis Vincent emphasizes the fact that in the diagnosis of brain tumors it is not so much a question of great knowledge of neurology as of method in examination that counts; further, that it does no good to wait long for the result of therapeutic tests in suspected cerebral gummas since these are rare; less than 2 per cent by American statistics and less than 1 per cent by French statistics. -C. R

Infections of the Urinary Tract. By T. E. Hammond H. K. Lewis & Co., Ltd., London, 1935. 250 pp. Price, \$2.25.

This monograph, many of whose chapters have already appeared in the Chancal Journal and in the Lancet, treats only of generative, coli infections, and staphylococcal diseases of the genito-urinary tract, but is otherwise well presented and bal-

anced. In the chapter on frequency of micturition, one is told that women pass arme less often than men, not because their bladders are larger, but because, owing to the absence of facilities, they accustom themselves to retention for long periods. In the chapter on the diagnosis of bacterial disease of the urinary tract is given much sound, common-sense advice as to how properly to secure urms specimens for examination, a simple enough thing, it would seem, but rarely attended to scrupulously. One carns with interest that in the author's practice 80 per cost of arinary infections in both sexes are due to Bacillus coli. Quoting Harrison, the author says that once catheterization was started for the enlarged prestrate the average duration of life was four years, death taking place from infection of the kidneys. He speaks of "macriage-bed" pyehibs, although the health of most women improves after marriage. To him it seems that natural immunity to the conococcus undoubtedly does exist. He believes that at present gonorrhoa is treated more efficiently than before the war, but this is due to diffusion of knowledge rather than to any advance in treatment. One is rather surprised to read that many students qualified without having a case treated or without having heard a lecture. The author lays emphasis on the bearing of the constitution upon generalized, and upon that of disease upon the course of gonorrhon. Age, he believes, does produce same variation in the lesion that is produced by the staphylococcus, and he gives illustrations in support of his contention. The chapter on staphylococcal disease is particularly illum nating

Unusual to a book of this kind are three appendices, one of which is on the bearing of the constitution upon bacterial disease, and the others on the practice of medicine, which make very interesting and illuminating reading, particularly the latter, from the standpoint of present medical education. In the first appendix the author elaborates on the theory of hyperathenic and hyposthenic types of constitution, at the same time giving a summary account of the theories which this thing that passes as constitution or something has undergone at different periods in the history of medicine, —C. R.

Sex Habits, a Vital Factor in Well-Being. By A. Buschke and F Jacobsohn. Tr from the Gurman by Elim and Cedar Paul. Emerson Books, Inc., New York, 1933. 204 pp. illur. Precs, \$2.50.

This is the English translation of the work originally written in German by Drs. Abraham Buschke and Friedrich Jacobsoho. Doctor Buschke is a specialist in urology and dermatology, and he and his colleague, Doctor Jacobsohn, have distinguished themselves by their writings on sexual hygiene and venercal disease. The present work speaks of the interest both have taken in the importance of healthful sex living.

The book is one of the sanest written on the subject. Sex functions and sex problems are discussed clearly and without bias. By limiting themselves to factual knowledge alone, the authors have succeeded in amassing concise information which meets the needs of parents, ministers, legislators, jurists, social workers, and others who deal with sex problems.

The anatomical and scientific descriptions alone are enough justification for the existence of this book. These with the chapters on puberty and sex impulses will serve as clear guides to parents in handling the many problems they have to face. The discussions on sex abnormalities also will give better understanding of conditions generally vague to the public, including some medical practitioners.—U. D. M.

The American Farmer and the Export Market. By A. A. Dowell and O. B. Jenness. The University of Minnesota Press, Minneapolis, 1934, 209 pp. Price, \$2.

By getting down to the facts and presenting them as they are, the authors bring together all the factors affecting the American farmers and the distribution of their products into an interpretative discussion uncolored by speculative theories and open to intelligent consideration. The book covers a range of vital subjects from the present agricultural conditions to the problems of international trade with illustrations and maps scattered here and there calculated to give the reader a more comprehensive grasp of the topics dealth with.

The opening chapters deal with the fundamental characteristics of the present American agricultural resources and the different improvements introduced in the way of increasing the output of the farm. Crop production is analyzed from the standpoint of acreage devoted to crops and in its relation to topography, chimate, and other factors that affect agricultural production in different localities. Dairying and alumal production are similarly treated. Thus, the reader is furnished with sufficient background for the later chapters that touch on overproduction and distribution. The trends of production exports, population, and consumption and their interrelations are pointed out. The cityward movement of populations is discussed to

illustrate its bearing on the present agricultural conditions of the United States. With the decline of the per capita consumption of food the question arises: Is underconsumption instead of overproduction, as is now popularly believed, the real core of the problem? The authors attempt to give a broad answer by displaying the outstanding facts from every angle, without, however, pinning too much hope on increased consumption

After discussing the effects of modern methods of agriculture on labor replacement and surplus production, the authors turn to the possibility of shifting from export to import products with the aim in view of adjusting agriculture to a basis of self-sufficiency. In this connection a suggestion has been advanced to restrict importation of eccount oils which principally comes from the Philippines, in order to give way to domestic butter production. But then, the authors remark writingly, to climinate coconut oil is to chiminate oleomargarine, soap, and other oil products manufactured in the United States. Such elimination, the authors contend, would havely be in the domestic favor. Limitation of sugar importation from the Philippines was once suggested by some Americans as a method of increasing domestic production of the product. Again, the authors believe, such action would hardly provide additional protection to domestic Droducers.

The next chapters are concerned with the question of the practicability of self-sufficiency in regard to agricultural production and with the position of the American farmer in the world production of wheat, corn, and colton and the possibilities attendant thereto. In the course of the discussion of the protection of farm products, attention is turned towards the subject of governmental policies in international trade. Mention is made of the marked interest all countries have shown since the World War in trade policies, balance of trade, and international trade cooperation. The closing chapters cover the most important recent developments in economic nationalism in America, prominent among which are the Agricultural Adjustment Act and the National Recovery Act which have largely been responsible in arousing national consciousness and paulic opinion anent economic problems, whose manifold questions and complexities remain to be solved .-- L. Ma C.

Vanishing Farm Markets and Our World Trade. By T W Schultz. (World affairs jumphlets, No. 11.) World Peace Foundation, Boston and New York, 1935. 41 pp. Price, \$0,50. This book is everything that its title implies and gives a vivid picture of the gradual disappearance of the form markets as offected by the present world trade of the United States.

The rise of the American tariff makes it difficult to sell foreign goods with a profit it, the United States. By thus reducing the purchasing power of other rations, this policy limits their capacity to absorb the United States surplus farm products. which they beretofore demanded. The author believes that if this situation continues grave adjustments are necessary for American agriculture. Neither the correction of its reciprocal tar.ff nor the operation of the Agricultural Adjustment Act or a similar act, which residers only a temporary improvement of farm products, is sufficient to meet the problem. The author suggests a more liberal foreign-trade policy as the best solution in order to incilitate a more normal cost and price level of agricultural products. The other method is the curtailment of production, but this will involve the shifting from one crop to another, which is quite difficult to achieve. The well-presented charts enhance the usefulness of the book.-F. G. G.

Criteria of Capacity for Independence. By W. H. Ritsher. American University of Berrut Publications of the Faculty of Arts and Sciences. Soc of Science Series No. R. Syrian Cephanage Press, Jertsalem, 1934. 152 pp. Price, \$2.

This painstaking study deals with the movements for independence in Iraq, the Philippines, and India. It describes the criteria for the independence of the three countries, one of which (Iraq) is already independent, and another (the Philippine Islands) is in its ten-year transition period for complete independence. The fate of British India in its movement for independence is still uncertain.

Professor Ritsher discusses the standards necessary for the recognition of new states or for admission into the League of Nations, with special emphasis upon the criteria of the capacity of Iraq in fulfilling the requirements set forth by the Permanent Mandates Commission in connection with her application for membership in the League.

The author considers as the first essential requirement for independence the maintenance of a stable government supported by (a) an administration capable of maintaining the regular operation of essential government services; (b) especity to maintain the territorial integrity and political independence, (c) the maintenance of public order and security throughout the whole territory, (d) adequate financial resources to provide

regularly for normal government requirements; (c) laws and a judicial organization which will afford equal and regular justice to all, and (f) a united public opinion supporting the Jemand for independent status. The existence of a clear intention to fulfill the international responsibilities and obligations, including (a) effective protection of minorities; (b) protection of the rights and properties of foreigners; (c) religious freedom; (d) obligations to assume public debts of the former administration; (c) the recognition of rights legally acquired under the former administration, is the second fundamental criterion according to the author, that has met with general approval.

As always happens, there has been a divergence of opinion between the mether country and the territory aspiring for independence. The author explains that this can be removed by the establishment of an objective and quantitative method to determine the amount of accomplishments by the natives in self-government. With the adoption of such a measuring rod, there would not be much quarrel as to the fitness of the subject countries for independence. The author forgets that due to the complex forces surrounding a colonial acquisition, it is utterly impossible to set up fixed criteria of the capacity of a subject people for independence. He admits, nevertheless, that the Indians, the Filipinos, and the Iraquis have the right to base their claims for independence on the principle of self-determination and the inalienable right of peoples to govern themselves and administer their own affairs.—F. M.

Incompatibility in Prescr.ptions and How to Avaid It. By Thomas Stephenson. 4th cet rev. and end The Prescriber Offices, Edinburgh, 1935, 62 pp. Price, \$2

This is the fourth edition of the work which originally appeared as a series of articles in the Prescr.ber, collected and first published as a 32 page pamphlet in 1915. It is intended to provide a more or less complete guide to prescribing, by treating the general principles of incompatibility and giving an alphabetical list of drugs with their doses, solubilities, and incompatibilities. The book, therefore, includes valuable facts about the latter which should prove of value in prescription writing. Obviously, however, not only physicians would we come this book, but pharmucists especially would find it of great assistance in dispensing.—B. M.

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